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AN INNOVATIVE APPROACH TO MATCH WHOLE CROP HARVESTING SYSTEMS TO EVOLVING INDUSTRY OPPORTUNITIES

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Final Report

Research Report

An Innovative Approach to Match Whole Crop Harvesting Systems to Evolving Industry Opportunities

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1. Abstract/Summary

The goal of this project was to provide a means to compare various options for whole crop harvesting. To achieve this goal, three objectives were outlined. They included:

- Providing a comprehensive analysis of the equipment, methods, results, and impact of the various systems for whole crop harvesting (full plant utilization).
- Conducting system design and field research to obtain complete performance criteria for systems identified in the analysis.
- Developing a tool for comparing the various methods to one another with the ability to change basic parameters that are key to the operation and economics of each system.

This project has defined the various options that are currently available for harvesting all of the basic components of crops grown on the prairies, namely, the grain, the chaff, and the straw. Each system was described, the required equipment defined, the operating procedure explained, and an analysis provided. After the analysis, the "missing" information gaps were prioritized. Within the scope of this project, it was not practical to conduct all of the research necessary to generate scientific data to fill in all of the blanks. A couple of projects were chosen based upon an assumption that key information from the tests would be crucial for completing this project and for directing future investigations.

The two "field" information gaps that were explored were to determine if round balers could provide an opportunity for faster and more timely harvesting by "rolling up" crop windrows for later processing. The second information gap that was explored was the practicality and efficiency of recovering straw from crop harvest by a "stripper header".

The baling trials indicated that with existing equipment there were severe limitations to this as an alternative harvest method. Most crop windrows were too wide to feed effectively into the baler, and the baler capacity was only about half of a combine. Therefore, at least three machines would be needed to gain an appreciable advantage in harvesting time over even a smaller than average capacity combine. Also, there did not appear to be an overall advantage in providing a more timely harvest as the straw had to be dry before baling, or heating and spoilage would quickly occur.

The second information gap was bridged through field trials where the amount of straw from typical direct cut headers on both conventional and rotary combines was compared to the amount of straw obtained after harvesting with the same combines using a Shelbourne Reynolds stripper header. In both cases, there was about 20% less straw mass for similar conditions. In the case of the rotary combine, it is estimated that the straw would have been about equal since the rotary combine's straw had significant

chaff admixed with the straw. However, in the case of the conventional combine it appeared that the lower straw recovery was indicative of the effect of the header equipment selection.

Using all of the collected information, a comprehensive comparative computer program was developed to show the impact of equipment selection, not only for harvesting the straw and chaff, but also in the selection of equipment for harvesting the grain. This is extremely important because the efficiency and profitability of the grain harvest is likely to significantly impact the need to extract value from the straw and chaff. Many factors were included. These ranged from the cost of crop production to ownership and operation of the equipment and all related crop component values.

This "tool" will have far reaching value not only for producers, but for industry, researchers, and analysts. Costs and benefits can be isolated yet still kept in context with the inseparable realities of total crop production.

2. Introduction

The concept of harvesting the "whole crop" is far from new. It was a fact of life and a general practice in the early 20th century in western Canada. The machinery of the time was designed to accommodate the needs of farmers who had as much need for the straw and chaff as they did for the grain. As agriculture intensified, the main product stream from grain farming was the grain/seed. The straw and chaff became nuisance by-products and products generally considered to be in a too abundant supply.

Recently, a few industries have looked upon this low value crop residue as a feedstock for industrial products. Their concerns have often been the logistics of cost effectively retrieving the desired material. There have also been concerns about consistent quality and quantity. Profitability must be balanced against the cost associated with guaranteeing supply and efficiently getting the material to the processing site, along with storage and disposal issues. This is a very simplified assessment. Many of the details are very complicated and present difficult challenges for establishing a viable industry.

The reasons farmers have become interested in selling grain production by-products have been fueled by extremely low grain prices. In order to be viable, every opportunity for increasing crop value has become of interest.

Another compelling factor has been public desire for a green or bio-based society. Escalating fossil fuel costs and fear of global warming have created a heightened desire to see maximum utilization of renewable (green) products and decreased dependency on fossil fuels.

There are several factors that continue to challenge the utilization of "whole crop". To start with, most industries are still developing the technology to provide a streamlined process that understands the variability of the feedstock so that they can produce consistent and cost-competitive products.

The logistics and associated costs of delivering a secure supply to sustain an industry result in raising feedstock prices to marginally economic rates. This then brings into the equation, "What is the producer getting out of it?" Typically straw and chaff prices at the producer level are low. They have some value if left on the land and retrieving them has an associated cost.

These factors mean that industry wants the best quality product and the largest supply close to the plant. The producer needs an economic incentive to supply the by-products, and there needs to be a cost-effective means of obtaining and transporting the

by-products along with companion systems that extract some value from waste products.

It must also be kept in perspective. Chaff and straw are by-products of grain farming. This means that grain production profitability is a necessity. If the only profitability lies in the value of the by-products, grain production will cease. If grain production becomes comfortably profitable, then the small difference that the by-products contribute may become inconvenient.

This project was designed to try to provide help to understand the opportunities and cost associated with harvesting the "whole" crop. It is important to note that this does not imply that the entire crop is harvested at one time and in one process, although that is a possibility.

It is believed that the complexity of bio-mass supplied by grain farming can be better understood through a thorough understanding of the economics of producing, harvesting, and selling a crop and how certain assumptions need to be made when working out logistics for an industry that must be integrated with farming.

The path chosen was to develop a computer program that utilizes a basic farm model for crop production. Reconfigurable variables would then allow adjusting the plan for common changes that occur in cost of production selection of crops, yield results, and potential price options.

The farm model (or plan) could then be subject to the impact of various machinery choices. The impacts would include the cost of ownership, the cost of operating, and operating time. All of these variables would be referenced to the effect upon the crop's potential value.

A question may be why such a complex procedure would be necessary. The fact is that no industry will survive without producer participation, and producer participation is dependant upon the work and investment required in relationship to profitability. The objective of this program is to provide a tool (method) so that interested parties can explore the many interactions that inevitably determine the practicality of whole crop harvesting.

3. Methods

One of the first tasks was documentation and evaluation of the various means of harvesting crop components, either individually or in combination. The machinery was identified, the procedure was outlined, and the process was analyzed as to what was known and unknown.

In some cases where knowledge gaps were apparent, some rudimentary field trials were employed to gather enough information to help complete the understanding of the system. In this case, field trials were conducted to determine the practicality of using a modern round baler for "rolling" up whole crop. Trials were done in barley, wheat, and oats. The practicality was assessed based upon the ability and rate that bales could be made relative to typical harvest rates with a combine harvester. As well, practicality was influenced by losses and the ability to store the crop.

Trials were also done in conjunction with other research to evaluate the results of using a stripper header. The key factors included harvest rates, losses, and the amount of straw that was available after harvest. A trial was conducted in wheat with a rotary and a conventional combine using both the stripper header and a rigid direct cut header (typical).

The key focus of this project was the development of a computer program that would enable the program user to explore the effect of changing variables in crop production and crop harvesting. The program was developed on an Excel spreadsheet platform that allowed linking between the crop production (Farm Plan), the harvesting sheets (Machinery Selection), and system summary and comparison sheets. The concept was that the Farm Plan establishes an economic basis in terms of cost to produce the crops and the amount of crop to harvest. This affects the work required and potential revenue (value) of the crop just prior to harvesting. The second part of the program would allow the user to select from a variety of machinery options for harvesting various crops. Imbedded with the selection of the equipment would be a host of variables that affect the cost of ownership and the cost of operating. Ownership costs would reflect mainly finance charges and depreciation. The rates need to be adjustable to show the effect of changing situations. The cost of operation has to reflect the impact of operating over a reasonable spectrum of work rates and incorporating how that effects time of operation and therefore labour and amount of equipment required, fuel use, and associated crop loss. The costs are subtracted from the potential crop value. The program then summarizes all of the equipment so that the system selection options can be compared.

PAMI was able to provide key information relating to the equipment options available, the work rates, losses, fuel use, and performance criteria of certain machines operating in the various crops.

4. Results

The results have been divided into three sections: The first is the assessment of the various crop harvesting options that are available. The second is the results from field experiments. The third section is the discussion of the computer program development, how it works, and what it shows.

4.1 Analysis of Crop Harvesting Methods

4.1.1 Cutting and Binding

Old (Binder)
Machinery

- Binder
  - 2 to 2.5 m cutting width
  - operating speeds of 3 to 4 km/h
  - work rates of only about 1 ha/h
- Tractor
  - 20 to 40 hp adequate

Procedure

- Crop traditionally was cut in the 15% to 25% grain moisture range.
- Required two people to operate the machinery.
- "Stooking" or standing up of the sheaves in bunches so that the crop would continue to ripen and dry in the field was very labour intensive and hard physical work with slow work rates (only a few acres per day per person).

Analysis

- Equipment that was developed is severely out of date and has not been used for nearly 50 years other than for demonstrations or for providing whole crop for laboratory experimentation.
- The equipment was small, labour intensive, and produced low work rates.
- Crop left in the field to cure was subject to rodent, wildlife damage, and impact of the weather.
- This method was certainly not an all crop mechanism. It would be suitable only for cereal crops.
- The advantage of this system is that the entire plant is left intact for subsequent processing.
- Cutting and binding took place in one operation.
- Losses would have been relatively low for crops that were at higher moisture content but could become significant in drier crops.

- It is possible that the system could be automated to increase capacity and minimize labour requirements.

New (Baler)

Machinery

- Windrower
  - Required prior to baling.
  - Current cutting widths of 7.6 m to 11 m (earlier models as narrow as 4.9 m).
  - Practical operating speeds up to 11 km/h (typical 7 km/h).
  - Operates in all crops.
  - Self-propelled and pull-type models available.
  - Power requirements from 30 kW to 110 kW.

- Balers
  - Three different types - round, small square, and large square.
  - Two types of round balers – fixed chamber (soft core) and expandable chamber (hard core).
  - Various sizes of round bales (1.2 m to 1.5 m wide and up to 1.8 m in diameter).
  - Small square bale 0.3 m to 0.4 m high X 0.5 m wide X 1 m long.
  - Large square bales 0.8 m or 1.2 m high X 0.9 m wide X 2.5 m long.
  - Plastic or sisal twine is available for round and small square bales.
  - Sisal twine for large square bales.
  - Plastic net wrap available for round bales.

- Tractor
  - Small square balers require 25 kW to 40 kW.
  - Round balers require from 50 kW to 75 kW.
  - Large square balers require from 115 kW to 150 kW.

- Bale Movers
  - Front-end loader (FEL) with bale fork (small square or round).
  - Round bale retrieval wagons (automated).
  - Semitractor/trailer units (road transport).
  - Larger square bale stackers (FEL).

- Storage
  - Stacked outside (covered or uncovered)
  - Shed
  - Plastic wrap

Procedure

- The crop has to be windrowed prior to baling.
- All balers use a reel type pickup.
- The round and large square balers have the tractor straddle the windrow.
- The bales can be removed from the field by mechanized loaders or with FEL attachments.
- Bales transported over more that a few kilometers require semitractor/trailers.

Analysis

- Both square balers cut the crop to fit into the compression chamber.
- Square baler plunger action forcing crop into the compression chamber tends to thresh grain from the heads.
- Round balers leave the crop more or less intact as it rolls it into a cylindrical shape.
- Net wrap on round bales provides the most complete coverage.
- Round balers are by far the most common baler available and used extensively.
- Balers pick hay and combined straw at speeds up to 14 km/h.
- The unknown factors were how well a round baler would pick windrowed grain crop, what rate of work could be achieved, if losses would be prohibitive, and what was suitable moisture content for safe storage.
- Round baling was chosen as a test option since the crop would be the least modified.

4.1.2 Forage Harvester

Machinery

- Windrower
  - Same as above for baler.

- Forage Harvester
  - Either self-propelled or pull-type.
  - Self propelled up to 450 Kw.
  - Pull-type up to 150 Kw.
  - Use a steel reel-type pickup.

- Forage Wagon or Truck
  - Silage box design needed for off-loading.
  - Some trucks and wagons pull behind.
  - Some trucks and wagons drive alongside.

- Handling Equipment
  - Screw conveyor
  - Belt conveyor

  - Pneumatic conveyor
  - Bucket loader

- Storage
  - Bins
  - Piles
  - Bunkers
  - Bags

- Processor
  - Thresh, separate, and clean grain.
  - Separate straw and chaff.

Procedure

- Forage harvesters can be equipped with their own headers, which are typically narrow and designed for green material and cutting very low to the ground. They also come with pickups for retrieving windrowed crops such as sun-cured alfalfa.
- The forage harvesters cut the harvested crop into small pieces and blow it through a discharge chute into a wagon or truck box.
- All of the material would require suitable handling equipment such as conveyors (belt, screw pneumatic).
- The material would have to be either separated first and then threshed and separated, and cleaned to retrieve the grain, or all of the material threshed and then separated and cleaned. This would have to be most practically done at a centralized site as opposed to on-the-go in the field.

Analysis

- Grain moisture from >20 to <10% would not appear to be a problem for a forage harvester as they normally operate in much higher moisture conditions but can also handle dry hay (sun-cured alfalfa).
- Grain crop would have to be cut by a windrower as the direct cut headers available for forage would be too narrow to exploit the larger machine's capacity.
- Since drying cost would be an added expense, the most desirable moisture would be < 15% .
- The entire crop would be chopped and blown into a truck in the same way that forage is harvested.
- Currently there is no processing system that has been developed specifically for this operation. Although it is possible that a combine might be able to process and separate the grain, chaff and straw in a stationary situation, but a suitable feeding mechanism would need to be developed.
- There are several unknown performance issues:

- Grain damage due to the cutters.
- If the straw chopped by the harvester would become an additional chaff component and become more difficult to separate from the grain without extensive equipment development.
- The density of the harvested product is unknown so the storage volume can not yet be calculated.
- It is unknown if a pure straw component could be easily recovered.
- It is unknown if straw from this process would be more or less suitable for industrial uses such as ethanol production, straw boards, or paper.
- The amount of energy required is unknown in relationship to other methods.

- Some of the perceived advantages might include:
  - Better overall density as compared to just straw or chaff.
  - The elimination of twine use.
  - Removal of product from the field would minimize interference with subsequent operations.
  - Removal should minimize the opportunity of contamination from wildlife, weather, and fire as compared to leaving it in remote areas.
  - The chopping may provide a beneficial step for preprocessing the straw for industrial treatments.
  - The damaged grain may be salvageable as feedstock that may be just as suitable as whole grain and nearly of equal value.

- Storage and transportation to a central processing site may become problematic.
  - It may be difficult to achieve an economical density for relatively efficient transportation.
  - Storage of large quantities of crop biomass may create fire hazards, increase management efforts to prevent waste and product degradation, and rodent problems.

4.1.3 McLeod Harvester

Machinery

- Windrower
  - May be required depending upon header choice.

- Tractor
  - 115 to 185 kW
  - Two- or four-wheel drive
  - PTO required

- Combine
  - Produced by only one manufacturer.
  - Pull-type
  - Pickup or direct-cut header of limited width.
  - Uses conventional threshing and separating technology.
  - Has no grain cleaning ability.

- Truck
  - Must be able to accommodate graff, a mixture of grain and chaff (larger box than required to handle the equivalent amount of clean grain).
  - Requires full endgate to allow dumping graff into feed deck.

- Cleaner
  - Produced by only one manufacturer.
  - Requires electricity or engine power to operate.
  - Stationary design is suited to central site.
  - Can run unattended.
  - Requires grain storage and chaff storage area.

Procedure

- Crop may be either windrowed or direct-cut.
- The crop is harvested in a normal manner.
- The straw may be either windrowed behind the combine or cut and spread with the combine's straw chopper.
- The grain truck receives the graff (a mixture of grain and chaff) from the combine's unloading conveyor. It dumps the material into an unloading deck that feeds the cleaner. The truck does not have to wait for the material to be processed.
- The cleaner's feed deck meters the graff into the cleaner, which separates the clean grain from the chaff using air and sieving action. The clean grain is discharged to a bin or another truck. The chaff and material that passes over the sieves is milled and blown into a pile.

Analysis

- Generally operates at the same crop moisture as the traditional combine harvesters (20% to <10%).
- It can be used in windrowed crop or with a direct-cut header.
- The work rates are similar to conventional combines of the same cylinder width.
- The McLeod harvester works in nearly all crops.
- The straw is left in the field either as a windrow of slightly damaged straw (same as for other conventional combines) or is chopped and spread back over the field.

- The graff leaves the harvester as a mixture. A separate processing mechanism (cleaner) separates these into their individual constituents.
- The density of the graff for different crops is not well documented although the manufacturer makes some suggestions. Once the graff is cleaned, the chaff is hammer milled and blown into a pile. The density for different crops is not known.
- This system is primarily focused upon the recovery of grain and chaff, leaving the straw to be recovered by other means.
- The value of the system has been promoted on the value of the chaff as an animal feed rather than for industrial use. It has also been promoted as offering grain saving that is equivalent to typical shoe loss, for reduced weed seed re-introduction onto fields, and for providing superior grain cleaning as compared to combines.

4.1.4 Stripper Header

Machinery

- Stripper Header
  - Widths up to 8.5 m available.
  - Adapts to most self-propelled combines.

- Combine Harvester
  - Self-propelled
  - Conventional or rotary

- Chaff Collector
  - Adapted to cleaning shoe discharge.

- Windrower
  - For cutting stripped stubble.
  - Pull-type or self-propelled.

- Baler
  - Baler options as listed previously (4.1.1 New Baler).

- Material-handling equipment
  - Grain augers
  - Belt conveyors or pneumatic conveyors for chaff.
  - FEL or bale movers.
  - Semitractor/trailers for moving bales.

Procedure

- The stripper header removes primarily the grain and chaff from standing crops that are suited to this type of harvest equipment. The straw is left standing.

- Chaff can be collected from the combine cleaner in the same manner that it would from a typical combine.
- Some experimental equipment has been used to remove the grain and chaff as a mixture (ASABE Paper # 061032).
- The stripped straw is left standing in the field.
- The stripped straw can be harvested with a combination of windrowing and baling equipment.

Analysis

- The stripper produces slightly less chaff than typical combine harvesters because very little straw is taken into the combine and broken into small pieces that end up in the chaff.
- Chaff collection is still limited to the existing collection equipment that has been designed for the combine harvester.
- The straw is left in the field and can be harvested later. Trials have shown that windrowing equipment will work. The amount (%) of straw recovery is not well documented for different crops and conditions. In recent trials associated with this project, the straw recovered was about 20% less than from a conventional combine using a rigid header. Similarly, there was also a corresponding 20% decrease from a rotary combine. However, in this case it was estimated that the difference was probably made up of chaff trapped in the straw as both were discharged together.
- The effect of tire tracks is not well documented.
- Preliminary results suggest that the straw from stripped crop is highly desirable for some industrial uses.
- Timing losses can be higher than for other methods of gathering. Associated trials suggest that stripping losses range from about 2% to 5% of yield, which were 2% to 3% higher than from a rigid header in the same conditions.
- Not an "all crop" harvesting option.

4.1.5 Typical Harvest Technique

Machinery

- Windrower
  - Self-propelled or pull-type.
  - Width to suit combine harvester.

- Combine Headers
  - Pickup for windrowed crops.
  - Rigid auger, flex, or draper headers (readily available).

- Combine Harvester
  - Pull-type or self-propelled.

  - Conventional or rotary.

- Chaff Collector
  - One commercially available (Redekop).
  - Dump wagon towed behind the combine.

- Balers
  - Small square, round, and large square.
  - Plastic or sisal twine.

- Bale-Moving Equipment
  - Round bale movers
  - FEL
  - Stackers
  - Semitractor/trailer

Procedure

- The components of whole crop, Material-Other than-Grain (MOG), can be retrieved when using the traditional harvest method. The chaff must be collected from the combine cleaner. The straw is typically baled after passing through the combine and dropping into a windrow.
- Chaff typically is blown into a small wagon that dumps the chaff onto the ground in a pile. Each pile is approximately 2 m^3 to 4 m^3. The chaff can later be scooped up with an FEL or a blower mechanism (like a snow blower) that will transfer the crop into a large truck box or wagon box.
- The windrowed straw can be baled after the crop has been combined. The bales are retrieved from the field with either FEL attachments that lift the bales onto a truck, or the bales can be scooped using self-loading bale wagons (trucks). The bales are often stacked in the field for storage until they are moved to central processing.

Analysis

- As a method, this system has the least impact on normal harvesting. The equipment needed is "add-on", which enables the producer to pick and choose the limits of what is most suitable for the particular operation.
- The machinery and methods used for harvest impact the quality and quantity of chaff and straw that is available for any given crop.
- Each industry has different requirements, depending upon the process.
- Generally, practices have shifted toward shorter crops, cutting higher, and using rotary combines. This has increased the chaff as a percentage of the total MOG. This means that some of the straw has been broken into small enough pieces to make its way from the separator into the cleaner. The aggressive processing of the

straw also makes it less suitable for some industrial uses and reduces the amount that can be realized by the producer.

In summary, there are machine combinations that currently offer producers the ability to recover most of the crop that they produce. A limited number have utilized chaff collection, primarily on mixed farms that raise cattle. The chaff provides a feed source that can be integrated into suitable feed rations. To date, there has been little demand for chaff as any type of industrial feedstock although cracked and damaged grain and weed seeds are suitable for grain ethanol production.

Straw is easily recovered after harvest. If ethanol production from cellulose becomes common, demand for straw may increase. Currently the demand for industrial purposes is still limited. In areas where there has been demand, relatively effective methods for recovering straw have been demonstrated.

4.2 Field Experiments

4.2.1 Baling Whole Crop

During the first season, field trials were conducted in barley, oats, and wheat to assess the suitability of using a round baler to roll up whole crop for processing later. The assumption was that balers are used to bale straw and are able to operate at a much faster ground speed than the combine that harvested the crop. If whole crop could be baled at this same rate, harvest time would be greatly changed. The crop could be quickly retrieved from the field minimizing risk of deterioration due to weather and providing an opportunity to process the crop later at a centralized site. This could make use of alternate power sources, utilization of the by-products, and more efficient processing equipment.

The barley crop became overripe by the time the test could be completed, due to unseasonably wet harvest weather. The heavy stand and advanced maturity made normal windrowing with a 36 ft cut windrower seem impractical. The cutting width was reduced to half (18 ft). One cut was made going south across the end of the fields, and a second windrow was made going north. The windrows were still too big. They barely fit under the tractor, and at times, were wider than what would comfortably fit between the tractor's front tires. This prevented any weaving that would typically be done in forming a bale properly. Baling was surprising slow. The maximum travel speed was only about 1.5 mph. This was even slower than what a combine would travel for a 36 ft windrow.

The losses due to baling appeared to be low in comparison to the loss from the windrowing. Windrowing losses were high because of the advanced maturity resulting in head loss over the cut width. As well, shelled loss was carried to the windrow opening

and formed a significant path of grain on the ground. A total of six bales were made with an average bale weight of 1,180 lb. These were harvested from 0.84 ac for a combined yield of 8,430 lb/ac (9.46 t/ha).

An oat crop that was standing had green straw but dry oats. A swath was cut and four bales were made. Seed loss was excessive, and within 3 days, the bales were heating from the green straw.

The wheat crop had been windrowed for approximately two weeks. While in windrows, it had several inches of rain on it. It was a 36 ft windrow that was too large to easily fit between the tractor's front wheels. As in the barley, baling was slow with a maximum speed of about 1.5 mph. A total of six bales were formed weighing on average 1,134 lb for a total of 6,840 lb from approximately 1 ac (7.7 t/ha). Baling speed was limited to 1.5 mph, and at times, the windrow would not fit between the wheels and into the baler in-feed section. After harvesting, the straw windrow from a conventional combine was baled. Over the same distance, only 2.5 bales were produced. These bales weighed 680 lb each for a total of 1,710 lb/ac (1.9 t/ha). However, baling speed increased to between 4 and 6 mph.

The conclusion from this experiment was that the present balers are not suitable for baling whole crop. It is possible that with modifications, a round baler could bale whole crop with some degree of efficiency. However, that was not within the scope of this project and would take considerable development resources.

4.2.2 Stripper Header

Agriculture and Agri-Food Canada has conducted plot trials comparing the performance of the stripper header to other harvest methods. Some demonstrations have also been done on larger-scale plots. This past season field trials were conducted in wheat and flax. The Flax Council supplied a Shelbourne-Reynolds stripper header. PAMI assisted with the trials in helping set up the equipment for other cooperators. The stripper header was compared to direct cutting in both crops. The results from these trials were far from conclusive. However, some informative trends seemed to emerge. **Appendix I** summarizes the results.

This was undertaken under a separate contract with AAFC, and that report is attached as **Appendix III**.

4.2.3 Industry Information

Another addition to this project was the hosting of seminars in March 2006 and 2007 to get input from industry and the scientific community. These seminars were both funded by AAFC, and PowerPoint presentations are attached in **Appendix IV and V**. Many issues concerning the utilization of crop residue were presented. Two of the most

concerning issues for existing and emerging industry were the quality and quantity of straw and chaff that is now being produced through today's crops, cropping practices, and machinery used. These issues suggest that viability for the industry and the producer may well be dependent upon harvesting equipment and methods.

They also identified many logistical problems where there is a lack of research regarding changes in straw depending on varieties and age of straw, desiccation, and processing and waste disposal issues.

4.3 The Computer Program "Comparative Tool"

The computer program has been designed to serve as a demonstration tool. It is intended to show how the selection of harvesting equipment necessary for whole crop harvesting would impact the producer. It soon became evident that in normal farming operations even simple changes can have significant effects. It seemed reasonable that, to be able to appreciate the effects, some reference was required to compare the change. As a result, a "Farm Model" was developed. This farm was of reasonable size so that more than one machine might be required for the same task. Several crops were selected to provide a variety of harvesting requirements. The model also had to accommodate similar crops that might yield differently so some variation was built-in. It also allowed for different pricing options that might typically occur for different grades or marketing options.

The very basic model produced a gross grain value and a value for some chaff and straw based upon assigning an amount of crop that might be used for these purposes. These gross values did not provide a realistic indication of potential profit prior to harvesting. In the real world, there are many costs associated with raising the crops to the harvestable stage. As a result, a second set of variable crop inputs was added to reflect production costs. All costs were attributed to growing only the grain since that is the primary focus of grain farming.

The results that were generated showed how low commodity prices, typical of 2006, left some crops with no profit margin even before harvesting. This prompted the need to build in an opportunity for a program user to explore the impact from price changes and different yield. To accommodate this, a second "Farm Plan" was introduced where variables could be changed, therefore, allowing the user to toggle back and forth between the plans to compare results. Some examples will be given later.

The machinery section was developed based upon categorizing all different types of machinery that could typically be used in the harvesting process. They were grouped under the headings "cutting and gathering", "harvesting", "grain handling", and "straw and chaff".

The machinery sheets provide several equipment choices within each type of equipment. They are roughly divided by value rather than specific size. In this case, a size was arbitrarily selected that would be suitable for this size of farm. However, to maintain flexibility several factors were left reconfigurable (grey areas) where the user could enter new values. This allows setting a specific value, how much of it is financed, what the finance rate is, and the depreciation rate. These directly affect the cost of ownership. The second area where the operator can make changes is to the operating parameters. The amount of area that will be covered by a particular machine can be changed if the operator intends to use several machines. The use must match the total area so a basic understanding is needed before simply accepting a selected array of machines. Also, the program user can specify the number of hours a particular machine will be used over the entire year when they are used for more than just during harvest. This applies to machinery such as tractors that are typically used throughout the year for various duties. It might also apply if a machine will be used for custom work. Specifics for fuel use, losses, work rates, and maintenance can be tailored to an individual's judgment representing his/her circumstances.

Even before selecting specific equipment, a good deal of information can be gleaned from any particular machinery sheet. The examples in the machinery selection sheets show the impact of ownership based upon the difference between the machines in a group that differ in value, amount financed, rates, etc. The cost of operating is also shown and is represented not only as total values but also on an hourly and an area basis. Finally, these costs are applied to the preharvest grain value margin to demonstrate the effect on the remaining value after that particular harvest task was performed by that machine. This may influence the program user to select certain machines for economic reasons. To see how this ends, the user can select different machine combinations for the different system choices. The systems will be comparable later.

As a cautionary note, this program does require that the user has reasonable knowledge of which machines go together to make up a system. For example, if windrowers are selected, then the combines will need to have a pickup. However, if a pull-type windrower is selected it has to have a tractor to power it.

The "yellow" system bands along the top of the columns allow the program user to select machines for a particular system by entering the number of times that machine will be included in the system.

Each machinery sheet follows the same basic format. The "Straw and Chaff" sheet has a few differences in that the crop values are specific to the straw and chaff depending upon the machine group's function as to recovering either straw or chaff. It is also

different in that none of the crop production costs are subtracted from the preharvest value of the straw or chaff.

Once machinery has been selected, the system can be reviewed on the System Summary sheet. If more that one system is created, then the second system will be displayed on the System 2 sheet. This can be done for both Farm Plan 1 and 2 (Farm Plan 2 has its own set of system sheets).

In order to compare these results, the system sheet's summary columns can be transferred to a "Summary Compare" sheet. This provides side-by-side results for the different plans and systems.

4.3.1 What the Program Shows – The Crop Options

Starting with the basic "Farm Plan 1", shown in **Appendix II**, we see that the farm is comprised of 2,300 acres of crop. The crops have been separated into two barley crops (because they have different yields), all of the canola has been grouped together, one pulse crop represents peas and one lentils, and the wheat has been split into two crops because of yield differences.

The prices for the crops have been set along the lines of prices typical of 2006. It was arbitrarily decided as to which crops would have straw and chaff available. Prices were set for each although there is no current chaff demand that establishes chaff price.

The orange band in the middle of the chart indicates the nominal grain value as a gross amount for each crop as well as what that would represent on a "per area" basis. Directly below, the same value for straw and chaff is presented. However, the grain value is quite meaningless because all of the input costs to grow the crop have not yet been considered. The green section on the lower half of the chart shows some typical costs associated with growing the different crops. Note that it has been assumed that all of the land is paid for. These costs are summarized as a per acre cost on the top of the section and as a total cost at the bottom. Once the costs have been subtracted from the grain gross value, the preharvest crop value margin is left or what the potential profit is as harvest begins.

Note that the growing costs have not affected the value of the straw and chaff as they have been considered by-products of growing the grain, which was the prime objective of the farm.

The bottom orange-coloured band represents the preharvest crop value. It is easy to see that the value has poor correlation with the price of the crop, amount of acres, or the gross value. A dramatic indication is canola that has the highest gross value but ends up as having a negative profit margin even before it is harvested.

An important consideration is the potential return based upon the investment so a preharvest grain value as percent of cost of inputs has been provided. It is easy to see that barley 2 and the pulse crops provide the best return efficiency.

Another important comparison check is between barley 1 and barley 2. Barley 1 ends up with only half the preharvest potential of barley 2, even though barley 1 was produced on 3 times the area and was sold at the same price. The only difference was Barley 2's increased yield of 15 bu/ac. This 23% yield increase provided 2.6 times more potential preharvest crop value or more dramatically a 7.7 times return per acre.

The straw and chaff value of $4,280.00 and $19,847.00 totalling $24,127.00 provides the potential to increase the grain crop value by an additional 67%.

Farm Plan 1 also shows that for the investment of $324,640.00 for seeding the crop, the maximum potential crop value before harvesting is only $35,910.00 or about 11%.

Farm Plan 2 provides an opportunity for the user to explore what effect raising the price of the grains would have. In Farm Plan 2, shown in **Appendix II**, the prices for all crops have been raised 25%. The immediate effect is that the preharvest potential grain value has risen to $126,145.00 from the previous $35,910.00 or 3.5 times higher. The difference represents a 250% increase in potential grain margin.

The value of the straw and chaff, which have stayed the same, now represent an increased crop value of 19%. Although still a considerable increase, it may appear less compelling option than at 67%.

As interesting as these comparisons are, "the crop is not in the bin". Next comes the selection of equipment for harvesting the crop and determining the impact that selection has on the value of the crop.

4.3.2 What the Program Shows – Machinery Options

Based upon the Farm Plan 1 (FP1), it is obvious that there is not a lot of profit margin left after production for subsequent machinery expenses. In System 1 (SYS1), a selection of machinery was put together that would be somewhat typical for a farm of 2,300 ac of crop. Note the straw and chaff values are still included as an assessment tool.

In Farm Plan 2, a selection of equipment for harvesting chaff and straw was based upon what was deemed necessary to conduct fairly complete handling of the MOG. In this scenario, it was decided that the farmer would collect the chaff and bale the straw. The straw price has not been changed to reflect baling costs, which may be higher than the value of the straw when demand is low.

Sheet 1E Farm Plan 1–System 1 in **Appendix II** shows that for the grain harvest, the machinery investment is approximately equal to the gross grain value ($351,000 vs $356,000). The cost of owning this equipment could easily be greater than the value of the crop just before harvest. Obviously, owning the equipment outright minimizes cash requirements. The depreciation is also often disregarded because it may not represent an immediate expense. However, it becomes very real when its decreased value and the inflated cost of replacement need to be factored in.

Operating costs represent cash expenditures incurred when running the equipment. There is no escape from fuel costs. Some years the maintenance costs may be lower than others due to the timing of expensive failures, but sooner or later, they average out. Labour may be somewhat variable. Sometimes the owner or owner's family operate the equipment, but it is becoming more common that additional paid help is required. In this case, that could represent a difference of about $5,500 to $9,000 or about 1/3 to 1/2 of the operating cost. This may become either cash outlay or added as a positive increase to the profit margin. It is interesting to note that there is little difference between the totals for operating at the high rates vs the low rates.

Under CROP VALUE (the bottom red band), the effect of losses incurred during harvest have been calculated. The myth that "if grain prices are low then the losses do not really amount to much" is evidently quite wrong. The spread between minimal loss and high losses is over $20,000, enough to pay operating expenses.

It is obvious from the remaining crop value, that if all expenses are included, there is no chance of any potential profit from the grain. The only way to end up with positive cash is by disregarding depreciation, having no debt charges, contributing to the labour supply (without charge), and minimizing losses.

The MOG offers an opportunity to greatly affect crop value, especially if it can be sold without incurring any machinery costs. As a grain by-product, all expenses for growing the crop have been charged against the grain. In this situation, the MOG could increase crop value by about an additional $20,000 to $24,000.

In order to capitalize on the value of chaff, some investment would be necessary as harvest time is the only opportunity to capture this product. Even a minimal one-time investment of $3,500 would be greater than the potential yearly revenue. This means that it could take several years to be able to recover the investment while still providing a reasonable revenue boost.

Straw may offer a more accessible opportunity with a higher financial impact. Straw could be simply dropped from the combine and left in windrows in the field without expense to the farmer. This may in fact provide a slight benefit from reduced fuel use

during combining compared to when running a straw chopper. Revenue without added machinery expense would certainly be the best option for the farmer.

If the farmer already has baling equipment, the straw may allow him to more fully utilize this equipment so that his investment cost could be spread out through greater use. It is likely that the price for baling straw should be added to the price of straw specified in the Farm Plan because actual costs for baling may be as much as or more than the value of the straw.

In FP1–SYS2, the MOG equipment operating cost reduces the potential from MOG providing a small margin when the cost of owning the equipment is taken into account. The machinery value is much more than the value of the MOG crop.

Farm Plan 2 was created to show how a price increase for grain would affect the same farm operation. In this case, the original machinery lineup was applied. The value of the grain just before harvest greatly increased so that now even with machinery ownership cost included there is a chance for a profit margin. The impact of the MOG machinery in Farm Plan 2-SYS2 now ends up having a smaller effect on margin (only 8% to 26%).

This demonstrates the difference in perspective that could occur depending upon grain prices. When prices are low, the potential of the MOG to offset losses becomes attractive as it substantially increases cash flow. However, when there is a positive margin from the grain, then the extra work and possible expenses for utilizing MOG become questionable. The price for the MOG would need to reflect a positive balance when leaving it in the field, or the cost of gathering the MOG would have to be profitable over and above the price paid for the MOG.

It must be remembered that these are demonstration scenarios. The variables for ownership, selection of equipment, and the use for other purposes can all be reconfigured, and the results will change. A program user can adjust the situations and develop many different conclusions. For example, reducing machinery as a means of achieving a better margin inevitably creates other considerations such as the time that is required to complete the harvest. That in itself may create risks, such as grade loss, that could offset the intended margin gain.

This is not the end of the process. The grain that leaves the field still has to be safely stored. That may mean drying or aeration. Also, the crop still has to be marketed, and there are further costs associated with transportation and handling charges. As well, at this time there are no reliable markets for MOG.

This tool does allow for experimentation to create scenarios that can be compared to explore possible outcomes for utilizing components from the whole crop.

5. Conclusions and Recommendations

Recently, there has been considerable attention directed toward the green movement, which strives to utilize renewable resources to the fullest. In the agricultural sector, this has meant utilization of the by-products from grain production, namely straw and chaff (Material-Other than-Grain or MOG). This project looked to see if "whole crop harvesting" is a realistic possibility. One of the first steps was to review the equipment that is in place and if it is suitable for the purpose. The review suggests that:

- The grain harvesting equipment is well developed for rapid efficient harvesting.
- Chaff collection is possible but has not been well developed. There are chaff bunch wagons, cyclones to drop chaff onto straw, some chaff spreaders that deposit chaff in with the straw, and a combine that puts the chaff in with the grain.
- Straw can be easily handled by current baling equipment designed for hay.

Exploration of "whole crop harvesting" proved to be problematic. Current round baling equipment was not compatible with grain crops. Crop feeding was not suitable. Windrows were too wide for existing equipment, and capacity was much less than the combine harvesters. Losses were not prohibitive, but crop moisture was critical. Greener straw resulted in heated bales in a very short time. The results suggest that a totally redesigned baler would be required if this route was pursued.

Industries that are looking at straw and chaff as feedstock for industrial purposes have raised questions as to the quality and quantity that may be available. The current trends in harvesting seem to be moving in an opposite direction with the new machines creating poorer quality straw and less useable quantities. These factors raise the price of getting feedstock to the processing plant. Field trial results and in-field testing was done to see if stripper technology offers a viable opportunity. Although the results look somewhat positive on those issues, the integration with farm practices is still questionable.

Although the first part of the project and the extra related activities provided good background information, the second part of the project has provided the most useful results. The goal was to develop a program that would allow a user to work with a computer model to explore the impact marketing MOG, and the impact of machinery selection on profitability.

The program that has been developed first looked at the potential revenue that might be available from a farm model. The assumption was made that the prime objective was to raise grain/seed, and the MOG was a by-product so all costs for production were charged against the grain value. Since there is no consistent market for straw and chaff, estimated values were used for MOG. The general consensus in industry is that those commodities must be priced very low because of the high cost of getting product to a

processing plant, and because most processing is still at a development stage, the efficiency benefits of a mature system have not yet become available.

Plant and soil scientists have suggested that there may be some value from leaving MOG on the field.

The program has demonstrated one very critical situation that is often overlooked when assuming that grain by-products will be available. If grain can not be raised profitably, then supply will be in jeopardy! The program shows that in the model, the cost of producing grain is far too high for potential revenue considering the risk and investment. Further, the machinery costs for suitable harvesting equipment almost guarantees negative return.

This makes the increased revenue from MOG look attractive as a supplement providing the farmer does not have to make further equipment investment for the MOG. However, the reality is that farmers will not grow traditional crops when they have to rely on MOG value to minimize financial losses.

The program provides an opportunity to explore what yields, prices, and investments would combine to provide an opportunity for viability.

Unfortunately, there are still many more factors that impact the final outcome. A similar system could be developed to show additional costs for storage, conditioning, transportation, and marketing. As well, a similar system for crop production would work nicely for feeding into the production costs of this program.

It is recommended that:

- A similar program be developed for estimating the impact of machinery selection for crop production to the harvesting stage.
- A similar program be developed for estimating the impact of machinery and marketing cost that may be incurred between harvesting and final sale.
- A similar program as this be developed specifically for farmers to easily enter their farm and machinery data as a reference base to aid in machinery selection and MOG utilization.
- That this program be used to help explore the opportunity for developing guidelines for price and yield combinations with respect to machinery investment that would be required for farming viability.

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7. Literature Cited

Hill, L.G. and G.E. Frehlich. 1985. Effects of reducing MOG/G on combine performance. ASAE Paper No. 85-1577.

Hoemsen, R.P. and R.P. Zentner. 1987. A farm-scale whole crop harvesting experiment. CSAE Paper No. 87-205.

Leduc, P., L. Hill, D. Kelly, and Dr. E. Coxworth. 1995. Assess swathing and baling as a whole crop harvesting method for high yielding wheat production for utilization as biomass for ethanol production. A study funded by Agriculture and Agri-Food Canada.

Manitoba Agriculture, Food and Rural Initiatives. 2005. An economic assessment of the McLeod Harvest. Agri-Food Research and Development Initiative. http://www.gov.mb.ca/agriculture/research/ardi/projects/98-134.html [Cited Apr 24, 2005].

McLeod Harvest Inc. 2002. *McLeod Harvest* Spring 2002, Issue12.

Prairie Agricultural Machinery Institute (PAMI). 1976. B & K Bale Karrier 815. PAMI Report (11a)23.

PAMI. 1976. Farmhand model F126-B five-bale mover. PAMI Report (11a)21.

PAMI. 1976. Hesston 5200 round-up multiple bale mover. PAMI Report (11a)20.

PAMI. 1976. McKee Bale-Rustler. PAMI Report (11a)24.

PAMI. 1976. New Holland Model 85 bale handler. PAMI Report (11a)22.

PAMI. 1977. Belarus Niva SK-5 self-propelled combine. PAMI Report (4c)28.

PAMI. 1977. Co-op Implements 550SP swather. PAMI Report (4d)40.

PAMI. 1977. International Harvester 914 pull-type combine. PAMI Report (4c)25.

PAMI. 1977. John Deere 6601 pull-type combine. PAMI Report (4c)26.

PAMI. 1977. John Deere Sidehill 6600 self-propelled combine. PAMI Report (4c)27.

PAMI. 1977. Massey Ferguson MF655 swather. PAMI Report (4d)41.

PAMI. 1978. Allied 7 x 41 grain auger. PAMI Report (6e)89.

PAMI. 1978. Brandt Model 740 grain auger. PAMI Report (6e)92.

PAMI. 1978. International Harvester 4000 self-propelled windrower. PAMI Report (4d)51.

PAMI. 1978. John Deere 800 self-propelled windrower. PAMI Report (4d)52.

PAMI. 1978. Sakundiak HD7-41 grain auger. PAMI Report (6e)90.

PAMI. 1978. Sperry New Holland 1033 automatic bale wagon. PAMI Report (11a)138.

PAMI. 1978. Sperry New Holland TR70 self-propelled combine. PAMI Report (4c)53.

PAMI. 1978. Western Roto Thresh self-propelled combine. PAMI Report (4c)55.

PAMI. 1978. White 8650 pull-type combine. PAMI Report (4c)54.

PAMI. 1979. Brandt Auger Kleen. PAMI Report (6e)91.

PAMI. 1979. Co-op Implements 660 pull-type windrower. PAMI Report (4d)151.

PAMI. 1979. Hesston 6400 self-propelled windrower. PAMI Report (4d)118.

PAMI. 1979. International Harvester 75 pull-type windrower. PAMI Report (4d)150.

PAMI. 1979. International Harvester 1460 self-propelled combine. PAMI Report (4c)142.

PAMI. 1979. Kirchner model 70 automatic bale wagon. PAMI Report (11a)137.

PAMI. 1979. Massey Ferguson 760 self-propelled combine. PAMI Report (4c)143.

PAMI. 1979. Massey Ferguson 775 self-propelled windrower. PAMI Report (4d)116.

PAMI. 1979. Versatile 10 pull-type windrower. PAMI Report (4d)149.

PAMI. 1979. Versatile Hydrostatic 400 self-propelled windrower. PAMI Report (4d)117.

PAMI. 1980. Headsnatcher sunflower harvesting attachment. PAMI Report (4c)162.

PAMI. 1980. John Deere 7721 pull-type combine. PAMI Report (4c)190.

PAMI. 1980. Massey Ferguson 751 pull-type combine. PAMI Report (4c)191.

PAMI. 1980. New J sunflower harvesting attachment. PAMI Report (4c)161.

PAMI. 1980. Stanley sunflower harvesting attachment. PAMI Report (4c)160.

PAMI. 1981. Allis-Chalmers Gleaner N-6 self-propelled combine. PAMI Report (4c)225.

PAMI. 1981. Bergen 40 grain auger. PAMI Report (6e)168.

PAMI. 1981. Brunetti Separ "B" crop divider. PAMI Report (4d)207.

PAMI. 1981. Co-op Implements 9600 pull-type combine. PAMI Report (4c)226.

PAMI. 1981. Delzer-Crary sunflower harvesting attachment. PAMI Report (4c)205.

PAMI. 1981. Eagle sunflower harvesting attachment. PAMI Report (4c)203.

PAMI. 1981. Farm King 7 x 41A grain auger. PAMI Report (6e)166.

PAMI. 1981. Glendale power swath separator. PAMI Report (4d)208.

PAMI. 1981. International Harvester 1480 self-propelled combine. PAMI Report (4c)224.

PAMI. 1981. John Deere 2320 self-propelled windrower. PAMI Report (4d)246.

PAMI. 1981. John Deere 8820 self-propelled combine. PAMI Report (4c)227.

PAMI. 1981. McIntyre 8 x 37 grain auger. PAMI Report (6e)167.

PAMI. 1981. OMC 280 self-propelled windrower. PAMI Report (4d)245.

PAMI. 1981. Versatile Hydrostatic 4400 self-propelled windrower. PAMI Report (4d)244.

PAMI. 1981. Westfield W80-41 grain auger. PAMI Report (6e)165.

PAMI. 1981. Zach sunflower harvesting attachment. PAMI Report (4c)204.

PAMI. 1982. Sperry New Holland TR95 self-propelled combine. PAMI Report (4c)287.

PAMI. 1982. White 9700 self-propelled combine. PAMI Report (4c)288.

PAMI. 1983. Allis-Chalmers Gleaner L2 self-propelled combine. PAMI Report (4c)311.

PAMI. 1983. Blanchard 8 x 50 grain auger. PAMI Report (6e)320.

PAMI. 1983. Claas Dominator 106 self-propelled combine. PAMI Report (4c)312.

PAMI. 1983. Farm King 8 x 41 grain auger. PAMI Report (6e)318.

PAMI. 1983. Massey Ferguson 860 self-propelled combine. PAMI Report (4c)313.

PAMI. 1983. Scoop-A-Second 8 x 46 grain auger. PAMI Report (6e)319.

PAMI. 1983. Sperry New Holland 8500 round bale wagon. PAMI Report (11a)305.

PAMI. 1983. Westgo 1210 grain auger. PAMI Report (6e)321.

PAMI. 1983. Willcar Autotran 2500 pull-type windrower. PAMI Report (4d)306.

PAMI. 1984. Allis-Chalmers Gleaner N7 self-propelled combine. PAMI Report (4c)365.

PAMI. 1984. Blanchard 5 x 16 drill fill. PAMI Report (6e)332.

PAMI. 1984. Brandt 5 x 15 drill fill. PAMI Report (6e)333.

PAMI. 1984. Co-op Implements 742 self-propelled windrower. PAMI Report (4d)353.

PAMI. 1984. Keer Shear RKS crop divider. PAMI Report (4d)325.

PAMI. 1984. New Holland TR85 self-propelled combine. PAMI Report (4c)364.

PAMI. 1984. Wallis Ptl 130 double windrow attachment. PAMI Report (4d)359.

PAMI. 1985. Agri-Box drill-fill system. PAMI Report (6e)418.

PAMI. 1985. Bergen 50 SD swing away auger. PAMI Report (6e)417.

PAMI. 1985. Blanchard end gate drill-fill system. PAMI Report (6e)419.

PAMI. 1985. Brandt 10 x 60 swing away grain auger. PAMI Report (6e)410.

PAMI. 1985. Chaff Storm chaff spreading attachment. PAMI Report (4c)436.

PAMI. 1985. Farm King 10 x 50 grain auger. PAMI Report (6e)409.

PAMI. 1985. Haukaas pull-type windrower stabilizer attachment. PAMI Report (4d)404.

PAMI. 1985. Hurricane chaff spreading attachment. PAMI Report (4c)438.

PAMI. 1985. John Deere 7720 Titan II self-propelled combine. PAMI Report (4c)426.

PAMI. 1985. John Deere 8820 Titan II self-propelled combine. PAMI Report (4c)425.

PAMI. 1985. Massey Ferguson 613 pull-type windrower. PAMI Report (4d)403.

PAMI. 1985. Sperry New Holland 1100 self-propelled windrower. PAMI Report (4d)402.

PAMI. 1985. Straw Storm straw and chaff spreading attachment. PAMI Report (4c)437.

PAMI. 1985. Swift pull-type windrower stabilizer attachment. PAMI Report (4d)405.

PAMI. 1985. Westfield TR100 x 51 grain auger. PAMI Report (6e)408.

PAMI. 1985. Wheatheart safety auger assembly. PAMI Report (6e)458.

PAMI. 1986. Forster Model 40 round bale mover. PAMI Report (11a)493.

PAMI. 1986. Fuma Sabre crop divider. PAMI Report (4d)477.

PAMI. 1986. Massey Ferguson 505 round bale mover. PAMI Report (11a)485.

PAMI. 1986. Massey Ferguson 885 self-propelled windrower. PAMI Report (4d)476.

PAMI. 1986. Muxlow Super Swather Model 21-21 tractor mounted windrower. PAMI Report (4d)475.

PAMI. 1986. New Holland TR96 self-propelled combine. PAMI Report (4c)474.

PAMI. 1986. Versatile Trans-Axial 2000 pull-type combine – interim report. PAMI Report (4c)499.

PAMI. 1987. Case IH 1660 self-propelled combine. PAMI Report (4c)531.

PAMI. 1987. Laurier H4250 round bale mover. PAMI Report (11a)522.

PAMI. 1987. Morris M-881 hay hiker round bale mover. PAMI Report (11a)516.

PAMI. 1987. Versatile Trans-Axial 2000 pull-type combine. PAMI Report (4c)532.

PAMI. 1988. Cereal Implements 722 self-propelled windrower. PAMI Report (4d)540.

PAMI. 1988. Cereal Implements 9850 pull-type combine. PAMI Report (4c)575.

PAMI. 1988. Don 1500 self-propelled combine. PAMI Report (4c)576.

PAMI. 1988. Honey Bee TM-50 Series III tractor mounted windrower. PAMI Report (4d)573.

PAMI. 1988. Knudson square bale stacker and mover. PAMI Report (11a)548.

PAMI. 1988. Mumby round bale mover. PAMI Report (11a)536.

PAMI. 1989. Case IH 1682 pull-type combine. PAMI Report (4c)600.

PAMI. 1989. Cereal Implements 9850 pull-type combine-series 64005. PAMI Report (4c)596.

PAMI. 1989. Crary air reel. PAMI Report (4c)590.

PAMI. 1989. Crary finger air reel. PAMI Report (4c)591.

PAMI. 1989. Hesston 8100 self-propelled windrower. PAMI Report (4d)595.

PAMI. 1989. Keho wind reel. PAMI Report (4c)589.

PAMI. 1989. Laurier H2125 round bale mover. PAMI Report (11a)593.

PAMI. 1989. Wilger Stripper II snow trapping attachment. PAMI Report (4d)592.

PAMI. 1990. Case IH 1680 self-propelled combine. PAMI Report (4c)629.

PAMI. 1990. Cereal Implements 702 pull-type windrower. PAMI Report (4d)632.

PAMI. 1990. John Deere 9500 self-propelled combine. PAMI Report (4c)631.

PAMI. 1990. Massey Ferguson 8560 self-propelled combine. PAMI Report (4c)622.

PAMI. 1990. Pulse crop cutting equipment. PAMI Report (4d)633.

PAMI. 1991. Ford New Holland TR96. PAMI Report (4c)649.

PAMI. 1991. John Deere chaff spreader. PAMI Report (4c)657.

PAMI. 1991. MacDon harvest header. PAMI Report 4(c)645.

PAMI. 1991. REM chaff spreader. PAMI Report (4c)656.

PAMI. 1991. Urvold straw/chaff spreader. PAMI Report (4c)655.

PAMI. 1992. Brandt 852 super-charged grain auger. PAMI Report (6e)690.

PAMI. 1992. Flexi-Coil 10-50 grain auger. PAMI Report (6e)689.

PAMI. 1992. Ford New Holland TX36. PAMI Report (4c)676.

PAMI. 1992. Kingsman RBM-217 round bale mover. PAMI Report (11a)674.

PAMI. 1993. AGCO R72 Gleaner. PAMI Report (4c)691.

PAMI. 1993. Redekop chopper. PAMI Report (4c)697.

PAMI. 1994. Case IH 1666 combine. PAMI Report (4c)710.

PAMI. 1995. Forage growers guide to round baling. *PAMI Research Update #717*, Group 4(i).

PAMI. 2001. Field tests to correlate biomass, combine yield and recoverable straw. PAMI Research Project No. 5000H, Agriculture Development Fund Final Report ADF#20000116.

PAMI. 2004. Flax straw recovery during combining and baling. PAMI Research Report Project No. 5402E, Agriculture Development Fund Final Report ADF#20020192.

St. George, D.R. 2000. The McLeod harvest system and ethanol production. International Fuel Ethanol Workshop and Trade Show, Windsor, ON, June 20-23, 2000.

Saskatchewan Agriculture, Food and Rural Revitalization. 2004. Farm machinery custom and rental rate guide 2004.

Siemens, M.C. and D.E. Hulick. 2006. Development of an alternative, reaper/flail based harvesting system for no-till farming. ASABE Paper No. 061032.

8. Other

8.1 PAMI Manpower Supplied

It is PAMI's policy to charge rates that include salary and benefits of employees as well as overhead. These charge rates do not include profits and to ensure that overhead is not charged to the project, indirect services, management time and use of PAMI equipment are provided at no cost. It has been calculated that this adjustment removes more than overhead costs from actual charge rates. It is PAMI's policy not to release individual salary information.

The following personnel worked on the project during this reporting period for a total of 1,350.5 hours:

Name	Title
Les Hill	Project Manager
Derek Rude	Project Leader
Nathan Gregg	Project Leader
Robert Cropper	Project Leader
Gordon Hultgreen	Project Leader
Hubert Landry	Project Leader
Kathy Lang	Project Leader
James Wassermann	Project Consultant
Philip Leduc	Project Consultant
Tyrell Bjarnason	Project Support
Peter Rhodes	Project Support
Gordon Doepker	Project Support
Errol Cross	Project Support
Myrna Britz	Project Assistant
Dianne Lepage	Project Assistant
Laurie Szautner	Project Assistant

Appendix I

Stripper Header vs Direct Cutting Field Results

KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss - Total - Combine	
				August		ha	h	kg	T	L	t/ha	L/h	L/ha	L/t	t/h	ha/h	km/h	kg/ha	kg/ha
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	26.4	8.3	131,447	131.4	370	5.0	44.6	14.0	2.8	15.8	3.2	3.6	< 220	< 150
JD 9610 W	SR 28 S	T.B.	5	30	wheat	19.3	5.0	82,542	82.5	237	4.3	47.4	12.3	2.9	16.5	3.9	4.7	220 - 520	<150
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	28.2	6.4	144,340	144.3	466	5.1	72.8	16.5	3.2	22.6	4.4	5.0	300 - 370	<75
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5	65,681	65.7		4.9				18.8	3.9	4.7		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0	49,420	49.4		4.4				24.7	5.6	6.8		
JD 9860 STS	SR 28 S	Farmer	3ab	29-30	wheat	24.6	5.5	115,101	115.1	337	4.7	61.3	13.7	2.9	20.9	4.5	5.4	370 - 520	<75
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.6	53,911	53.9	204	4.5	78.5	17.2	3.8	20.7	4.6	5.2		

R = Rigid Auger Header S = Stripper Header W = Walker STS = Rotary

KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Fuel	Grain Harvested		MOG Baled		GrainYield	MOG Yield	MOG/G
			#	August		ha	h	L	kg	t	kg	t	t/ha	t/ha	Ratio
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	26.4	8.3	370	131,447	131.4	79586	79.6	5.0	3.0	0.605
JD 9610 W	SR 28 S	T.B.	5	30	wheat	19.3	5.0	237	82,542	82.5	40010	40.0	4.3	2.1	0.485
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	28.2	6.4	466	144,340	144.3	42638	42.6	5.1	1.5	0.295
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5		65,681	65.7			4.9		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0		49,420	49.4			4.4		
JD 9860 STS	SR 28 S	Farmer	3ab	29-30	wheat	24.6	5.5	337	115,101	115.1	58670	58.7	4.7	2.4	0.510
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.6	204	53,911	53.9	34110	34.1	4.5	2.9	0.633

R = Rigid Auger Header S = Stripper Header W = Walker STS = Rotary

KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss -Total - Combine	
				August		ha	h	kg	T	L	t/ha	L/h	L/ha	L/t	t/h	ha/h	km/h	kg/ha	kg/ha
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	26.4	8.3	131,447	131.4	370	5.0	44.6	14.0	2.8	15.8	3.2	3.6	< 220	< 150
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	28.2	6.4	144,340	144.3	466	5.1	72.8	16.5	3.2	22.6	4.4	5.0	300 - 370	<75
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5	65,681	65.7		4.9				18.8	3.9	4.7		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0	49,420	49.4		4.4				24.7	5.6	6.8		
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.6	53,911	53.9	204	4.5	78.5	17.2	3.8	20.7	4.6	5.2		

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Fuel	Grain Harvested		MOG Baled		GrainYield	MOG Yield	MOG/G
			#	August		ha	h	L	kg	t	kg	t	t/ha	t/ha	Ratio
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	26.4	8.3	370	131,447	131.4	79586	79.6	5.0	3.0	0.605
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	28.2	6.4	466	144,340	144.3	42638	42.6	5.1	1.5	0.295
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5		65,681	65.7			4.9		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0		49,420	49.4			4.4		
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.6	204	53,911	53.9	34110	34.1	4.5	2.9	0.633

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

Appendix II

Farm Plan Spreadsheet and Documentation

A - Welcome to the whole crop utilization workbook!

Boxes B, C, D and E below give a quick overview. More detail about each step is given to the right

There are four types of worksheets in this work book. There are **FARM PLAN (FP)** sheets, **MACHINERY SELECTION (MS)** sheets, **SYSTEM SUMMARY (SS)** sheets and a **SUMMARY COMPARISON (SC)** sheet. The **FP** sheets are a source of information for calculations in the **MS** sheets. Machines selected from the **MS** sheets get transferred to the **SS** sheets to create a machinery system. The **SC** sheet utilizes summarized information from the **SS** sheets to allow easy side-by-side comparison of **FP** systems. There are two **FP** sheets, eight **MS** sheets and four **SS** sheets and one **SC** sheet. All sheets with a **1** in the title are based upon **FP1** and all sheets with **2** are associated to **FP2**

There are guidelines to help you calcualte amounts of straw and cheff for different crops

B About - The Farm Plan

You can see that this workbook is a typical Excel workbook. Along the bottom are a list of worksheets. There are really two sets of sheets identified by either 1 or 2. Number 2 sheets are a repeat of the number 1 sheets.

The **"Farm Plan"** sheet sets out an example of a farm, with various crops grown on specified acreage. Yield and Price determine the gross value that a particular crop will yield.

Each crop has specific costs associated with production. Once these are accounted for, then crop values prior to harvesting can be calculated.

Key variables such as fuel price and Labor are used in the **MS** sheets

Different crop examples are separated by crop performance (yield), or by price difference or by cost of production (i.e.. rent or payment charges).

Key variables for price, yield and production (in grey boxes) can be changed. Changing these values allows you to see the impact on the value of the crop.

The production part of the **FP** sheet gathers information about the costs of producing the crop. These rely on the users discretion and understanding of farming. The inputs can be changed to see the impact.

There are grey area at the bottom left for entering fuel and labor costs

If the owner is going to do the work labour can be deleted.

C - Machinery Selection Sheets 1A to 1D

The **machinery selection (MS) sheets** provide four groups of machinery for accomplishing **cutting and gathering, harvesting, grain handling** and **straw and chaff** tasks. Within each group (worksheet) there are several types of machines that may be used. Each machinery type includes choice of machines based primarily on value. The machinery options have been sized to be compatible with the farm size in the **FP**.
On each worksheet there is a section at the top (yellow band) where machines can be selected for each system associated with **FP**. Once machines have been selected for appropriate tasks the selections can be transferred to a **System Summary (SS)** sheet. This mean opening a **SS** sheet and following the instructions for transferring the equipment into that sheet.

MS sheets provide a good deal of information about any particular machine. The information relates to the cost of owning the machine, how much work it will do and what are the operating costs.

The information in the grey areas can be changed to suit a particular situation. The value of the machine, how much is financed and at what rate can be specified. Similarly, the work rates, fuel use and loss can be changed if specific experience dictates.

Each machine's costs are related to the impact on the pre-harvest crop value. In this way you can compare different machines before entering them into a system.

Above each machine are two yellow "System" bands. In each band there is a box directly over every machine column listed. By entering a number (1,2, 3 etc.) in a box selects the number of times that machine will be repeated as a selection. For example, if in System 1 you want one machine from column 3a, placing a 1 in the box above 3a means that that machine has been selected once for transfer to the summary sheet for Farm Plan 1-System 1.If you entered a 3 then three identical machines would be entered in the summary.

The grey area can be reconfigured to reflect different funding arangements and workrates or area of use.

Selecting a machinery lineup requires some understanding of what machinery is compatible with each other, for example a pull type windrow also requires selecting a tractor to power it.

D - System Summary

A **System Summary (SS)** sheet provides a view of all equipment selected for a Farm Plan and will be designated as a **"FP# - SYS#"** sheet. The machinery selection needs to be fine tuned to reflect which machines were selected for a given purpose. Once done, the overall impact can be evaluated for grain only, straw and chaff only and for the total crop value remaining. It shows which machines are costing the most to own and use. Considerable information is provided about cost per area covered and time of use. The hours of use calculated provide an opportunity to see how the time fits within the window of opportunity.

A second system can be created for each Farm Plan, to streamline equipment selection, integrate new machines or upgrade certain equipment. The second equipment system comes from the appropriate **FP** groups and is made on the pale yellow area in the same manner as the first system was selected.

With systems summaries when located on two different sheets makes it hard to compare them directly. By moving data to the **Summary Comparison (SC)** sheet the condensed results are shown side-by-side.

The instructions in the text box at the top of the **Summary Comparison (SC)** sheet **transfers** the selected **Summary Columns** from the **Farm Plan System** sheets. The results will be presented side-by-side.

It is best to select machinery from each group before transfering them to the System Summary.

The more you understand harvesting the more useful the data will be. For example, if at some point you select a stripper header and later want to harvest the straw, you will have to go back to "cutting" and ensure that you have also selected a windrower so that you can the standing straw before baling.

Once a system is created, certain variables have to be changed to reflect appropriate usage of the equipment selected. For example, if two windrowers are selected the area designated for windrowing must be divided between them proportionally to what seems reasonable. As well, if one of those windrowers is a pull type then the tractor selected to power it must have its acres of use aligned with those of the windrower. That tractor's use for the rest of the season will spread its ownership cost over its use entire year.

Saving Workbook and Resetting

What if I don't want to lose my Farm Plans?
Under "File" select "Save As" and make your own personal "workbook" Then continue exploring.

What if I want to get back to the original Farm Plan?
Don't worry you can reset the program back to original by following the instructions in the text box at the top of the Farm Plan sheets.

Farm Plan 1

Press "CONTROL& SHIFT & R" to Read Farm Plan 1 on the Original Data



Farm Plan 1

Press "CONTROL& SHIFT & R" to reset Farm Plan 1 to the original data

	CROPS											TOTALS			
	Barley 1	Barley 2	Canola	Pulse 1	Pulse 2	Wheat 1	Wheat 2	Other 1	Other 2	Other 3	Windrow	Direct Cut	Stripper	Total
	328 100	100	430	399	140	300 130	320							
	65	80	30	50	20	40	60							
Gross Bushels	20000 10400	0 12000	12900 0	0 19950	0 4360	12000 6900	0 19200	0 0	0 0	0 0	46300	67998	85400	199698
	2	2	5.5	3.5	0	3.5	3							
	430 400	430	730	399	280	480 410	480							
Total Chaff (tonnes)	86.2	32.7	153.4	40.9	12.7	82.7	58.2	0.0	0.0	0.0				469
	0.003	0.003		0.01	0.01	0.003	0.003							
	0.9 0.7	1.17	0.34	1	0.5	0.75 0.75	1							
Total Straw (tonnes)	400	187.2	153	399	70	337.5	339	0	0	0				1764
	10	10		20	20	10	10							
Gross Value Grain ($) by method	41600 20800	0 28800	74220 0	0 53865	0 25060	42550 21390	0 57600	0 0	0 0	0 0	157450	201782	234468	593700
Total Gross Grain Value ($)	$ 62,400.00	$ 28,800.00	$ 74,220.00	$ 53,865.00	$ 25,060.00	$ 63,940.00	$ 57,600.00	$ -	$ -	$ -				$ 365,885.00
Gross Grain Value ($/ac)	$ 130.00	$ 160.00	$ 165.00	$ 175.00	$ 160.00	$ 140.00	$ 180.00	#DIV/0!	#DIV/0!	#DIV/0!				
Gross Value of Chaff ($) (ac)	$ 1,080.00 480	$ 360.00 160	$ -	$ 900.00 300	$ 280.00 140	$ 1,020.00 450	$ 640.00 320	$ -	$ -		Chaff acres =	1850		$ 6,130.00
Gross Value of Straw ($) (ac)	$ 4,000.00 480	$ 1,872.00 160	$ -	$ 6,000.00 300	$ 1,400.00 140	$ 3,375.00 450	$ 3,200.00 320	$ -	$ -		Straw acres =	1850		$ 21,697.00
Gross Value Chaff - Straw ($/ac)	$ 2.25 $ 8.33	$ 2.25 $ 11.70	$ - $ -	$ 3.00 $ 20.00	$ 2.00 $ 10.00	$ 2.27 $ 7.50	$ 2.00 $ 10.00	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!				
	10	10	20	40	40	15	15							22.143
	59	59	66	13	13	66	66							44.29
	27.5	27.5	33	30	30	30	30							30.00
	3	3	4	3	3	4	4							3.43
	20	20	20	20	20	20	20							20.00
	8	8	15	15	13	19	19							11.57
	7	7	7	7	7	7	7							7.00
Preharvest Grain & Straw Value ($)	$ 6,160.00	$ 7,362.00	$ 450.90	$ 10,500.00	$ 8,400.00	$ 675.00	$ 14,660.00	$ -	$ -	$ -				$ 55,757.90

Harvest Equipment	
Cost of Fuel - Diesel ($/L)	0.65
Cost of Fuel - Gas ($/L)	0.55
Labour Rate ($/h)	15

Guidelines for calculating MOG (straw & chaff)

Typical MOG:Grain ratios for

	short straw	average straw	tall straw
wheat	low = 0.6 - 0.8	avg = 0.8 - 1.0	high = 1.0 -1.3
barley	low = 0.5 - 0.65	avg = 0.65 - 0.75	high = 0.75 - 1.2
canola	low = 1.0 -1.5	avg = 2.0 -2.5	high = 2.5 - 3
flax		avg = 2.0 - 2.5	

Typical chaff:MOG ratios for

wheat	Conventional = 2 - 4	Rotary = 25 - 65
barley	Conventional = 15 - 3	Rotary = 2 - 45
canola	Conventional = 15 - 30	Rotary = 25 - 65
flax	Conventional = 10 - 20	Rotary = 2 - 3

Example: Wheat with yield of 50bu/ac X 60 lb/bu = 3000 lb/ac of grain . for MOG/G of 1 then that means there is 3000lb/ac of MOG (chaff and straw) of which 30% is chaff so ther would be 900 lb of chaff and 2100 lb of straw

1A - Cutting and Gathering

SYSTEM 1

SYSTEM 2

Ownership Costs																				
Total Cost of ownership - High Rate ($/year):	29,700	16,800	4,200	1,500	1,500	420	150	5,250	1,800	180	18,900	10,800	3,600	7,500	4,500	2,250	180	21,250	5,000	2,200
Total Cost of ownership Low Rate ($/year):	14,850	8,250	2,100	750	750	180	60	2,625	900	0	9,450	6,250	750	3,750	2,250	1,125	0	6,375	2,500	1,100
Operating Parameters																				
Variable Input Operating Costs																				
Fuel Price ($/L):	0.80	0.80	0.85	0.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0.85	0.85	0.85
Operating Cost																				
Total ($) - High Rate	2,186	2,186	2,186	1,013	130	130	130	1,067	1,067	1,067	1,538	923	615	1,722	1,722	383	142	959	959	959
Total ($) - Low Rate	1,890	1,890	1,890	956	76	76	76	615	615	615	1,025	513	513	775	775	76	76	1,017	1,017	1,017
Calculated Cost Rates																				
Fuel Cost - High Rate $/h	14.85	14.85	14.85	19.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.25	16.25	17.23
Fuel Cost - Low Rate $/h	8.50	8.50	8.50	8.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.75	6.75	6.75
Fuel Cost - High Rate $/L	0.85	0.85	0.85	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.85	0.85
Fuel Cost - Low Rate $/L	0.42	0.42	0.42	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.45	0.45
Operating Costs - High Rate $/h	44.00	44.00	44.00	44.00	0.00	0.00	0.00	75.00	75.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	84.00	84.00	84.00
Operating Costs - Low Rate $/h	25.00	25.00	25.00	25.00	0.00	0.00	0.00	43.00	43.00	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.00	43.00	43.00
Operating Costs - High Rates $/L	2.54	2.54	2.54	2.54	0.00	0.00	0.00	4.50	4.50	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	4.50	4.50
Operating Costs - Low Rates $/L	1.50	1.50	1.50	1.50	0.00	0.00	0.00	2.58	2.58	2.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.58	2.58	2.58
Owning & Operating - High Rates ($/hour):	31,886	12,186	6,386	2,513	1,630	550	280	6,317	2,157	1,467	20,438	10,923	3,915	9,222	6,222	2,383	243	3,692	1,587	1,509
Owning & Operating - Low Rates ($/hour):	16,740	8,140	3,990	1,706	826	256	136	3,240	1,515	915	10,475	6,763	1,263	4,525	3,025	1,201	76	2,426	1,492	1,435
Owning & Operating Cost - High Rates $/h	170.92	152.74	153.01	153.69	62.69	21.23	10.79	94.65	43.34	29.48	130.12	77.50	24.78	142.61	96.22	36.84	3.75	56.04	24.09	22.90
Owning & Operating Cost - Low Rates $/h	89.68	102.04	95.80	91.20	31.74	9.74	5.26	48.54	21.92	12.30	66.72	47.98	7.99	69.99	46.77	18.56	1.17	26.94	16.57	15.94
Owning & Operating Costs - High Rates $/L	13.68	11.38	9.47	5.03	1.56	0.96	0.43	1.42	0.65	0.44	1.95	1.16	0.37	2.14	1.44	0.55	0.06	0.84	0.36	0.34
Owning & Operating Cost - Low Rates $/L	7.18	7.61	5.93	3.42	1.41	0.43	0.24	0.73	0.33	0.18	1.00	0.72	0.12	1.05	0.70	0.28	0.02	0.40	0.25	0.24
Crop Value																				
Crop Value - Production and High Loss($):	31,173	31,173	31,173	33,607	33,387	33,387	33,387	30,843	30,843	30,843	31,836	31,836	31,836	28,896	28,896	32,753	32,753	35,910	35,910	35,910
Crop Value - Production and Low Loss($):	35,121	35,121	35,121	35,541	33,490	33,490	33,490	33,683	33,683	33,683	34,897	34,897	34,897	28,896	28,896	35,594	35,594	35,910	35,910	35,910
Crop Value - High Rate of Operating Costs ($):	29,988	29,988	29,988	32,685	33,258	33,258	33,258	29,476	29,476	29,476	30,319	30,934	31,241	27,174	27,174	32,610	32,610	34,971	34,971	34,971
Crop Value - Low Rate of Operating Cost ($):	33,230	33,230	33,230	34,581	33,414	33,414	33,414	33,266	33,266	33,266	33,872	34,384	34,384	28,121	28,121	35,516	35,516	34,894	34,894	34,894
Crop Value - High Rate of Operating Cost ($/ha):	27.78	27.78	27.78	30.27	30.80	30.80	30.80	27.30	27.30	27.30	28.07	28.65	28.93	25.17	25.17	30.20	30.20	32.38	32.38	32.38
Crop Value - Low Rate of Operating Cost ($/ha):	30.78	30.78	30.78	32.03	30.94	30.94	30.94	30.80	30.80	30.80	31.37	31.84	31.84	26.04	26.04	32.89	32.89	32.31	32.31	32.31
Crop Value - Op. & Own Cost - High Rates($):	713	10,386	24,786	31,185	31,758	32,838	33,108	24,226	27,676	29,376	11,419	20,934	28,241	19,674	22,674	30,360	32,510	32,218	34,323	34,401
Crop Value - Op. & Own Cost - Low Rates ($):	16,350	26,980	31,130	33,841	34,664	33,234	33,354	30,643	32,368	33,268	24,422	28,134	33,634	24,371	25,871	34,393	35,518	33,682	34,419	34,476
Crop Value - Operating & Ownership Cost - High Rates $/ha	0.12	1.72	4.10	5.16	5.25	5.43	5.48	4.01	4.58	4.86	1.89	3.46	4.67	3.25	3.75	5.02	5.38	5.33	5.68	5.69
Crop Value - Operating & Ownership Cost - Low Rates $/ha	2.71	4.46	5.15	5.60	5.73	5.50	5.52	5.07	5.35	5.50	4.04	4.65	5.56	4.03	4.28	5.69	5.87	5.57	5.69	5.70

1A - Cutting and Gathering

Enter number (1, 2, 3 etc) for # of machines selected for each system in box above machine column (1a, 3b, 6a)																								
	SYSTEM 1			1			1			1									2					1
	SYSTEM 2			1			1			1									2					1
		1a	1b	1c	1d	2a	2b	2c	3a	3b	3c	4a	4b	4c	5a	5b	6a	6b	7a	7b	7c			
Option		1				2			3			4			5		6		7					
Machine Name		Windrower - SP - 30				Windrower PT - 30			Direct Cut - Auger -30			Direct Cut Draper - 30			Stripper - 26		Pickup		Tractor (100) for PT					
Selection		1a	1b	1c	1d	2a	2b	2c	3a	3b	3c	4a	4b	4c	5a	5b	6a	6b	7a	7b	7c			
Machine Value ($)		110,000	50,000	30,000	15000	10,000	6,000	3,000	35,000	15,000	5000	70,000	50,000	25,000	50,000	30,000	15,000	5,000	85,000	40,000	20,000			
Portion of Investment Financed (%)		70	50	40	0	50	30	0	50	20	0	70	50	20	50	50	50	0	50	25	10			
Financing Charges - High (%)		10	10	10	10	10	10	0	10	10	0	10	10	10	10	10	10	10	10	10	10			
Financing Charges - Low (%)		5	5	5	5	5	5	0	5	5	0	5	5	5	5	5	5	5	5	5	5			
Depreciation Rate - High (%)		20	15	10	10	10	5	5	10	10	2	20	15	10	10	10	10	2	20	10	10			
Depreciation Rate - Low (%)		10	10	5	5	5	2	2	5	5	0	10	10	2	5	5	5	0	5	5	5			
Financing Cost - High Rate ($/year)		7,700	2,500	1,200	0	500	120	0	1,750	300	0	4,900	2,500	500	2,500	1,500	750	0	4,250	1,000	200			
Financing Cost - Low Rate ($/year)		3,850	1,250	600	0	250	60	0	875	150	0	2,450	1,250	250	1,250	750	375	0	2,125	500	100			
Depreciation - High Rate ($/year)		22,000	7,500	3,000	1,500	1,000	300	150	3,500	1,500	100	14,000	7,500	2,500	5,000	3,000	1,500	100	17,000	4,000	2,000			
Depreciation - Low Rate ($/year)		11,000	5,000	1,500	750	500	120	40	1,750	750	0	7,000	5,000	500	2,500	1,500	750	0	4,250	1,000	1,000			
Total Crop Area for Farm (ac)		2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300			
Area of Crop Windrowed		1,070	1,070	1,070	1,070	1,070	1,070	1,070										1,070	1,070	1,070	1,070			
Area of Crop Direct Cut									1,230	1,230	1,230	1,230	1,230	1,230										
Area of Crop Scraped															1,550	1,550								
Use - Area of crop per year (ac)		1070	1070	1070	500	570	570	570	1230	1230	1230	1230	1230	1230	1550	1550	1070	1070	570	570	570			
Operating Time - Hear Work Rate (h)		49	49	49	23	26	26	26	68	68	68	62	62	62	57	57	71	71	26	26	26			
Operating Time - Lower Work Rate (h)		71	71	71	33	38	38	38	123	123	123	103	103	103	79	79	153	153	38	38	38			
Hours of Use for Year																			200	200	100			
Fuel Use Rate- High (L/h)		23	23	23	23	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	25			
Fuel Use Rate - Low (L/h)		10	10	10	10	0	0	0	0	0	0	0	0	0			0	0	15	15	15			
Loss - High (% of yield)		3	3	3	3	3	3	3	2.5	2.5	2.5	2	2	2	5	5	2	2	0	0	0			
Loss - Low (% of yield)		0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	0.5	0.5	0.5	3	3	0.2	0.2	0	0	0			
Work Rate Rate - Higher (ac/h)		22	22	22	22	22	22	22	18	18	18	26	26	26	27	27	15	15	22	22	22			
Work Rate - Lower (ac/h)		15	15	15	15	15	15	15	10	10	10	12	12	12	20	20	7	7	15	15	15			
Operator Labour Rate ($/h)		15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	15			
Maintenance Cost Estimate - High Rate($/h)		15	15	15	10	5	5	5	20	20	20	25	15	10	30	30	2	2	5	5	5			
Maintenance Cost Estimate - Low Rate ($/h)		5	5	5	5	2	2	2	5	5	5	10	5	5	10	10	0.5	0.5	2	2	2			
Cost of fuel - High Rate ($)		727	727	727	444	0	0	0	0	0	0	0	0	0	0	0	0	0	421	421	421			
Cost of fuel - Low Rate ($)		464	464	464	283	0	0	0	0	0	0	0	0	0	0	0	0	0	371	371	371			
Cost of Labour - High Rate($)		730	730	730	341	0	0	0	0	0	0	0	0	0	0	0	0	0	389	389	389			
Cost of Labour - Low Rate ($)		1070	1070	1070	500	0	0	0	0	0	0	0	0	0	0	0	0	0	570	570	570			
Maintenance - High Rate ($)		730	730	730	227	130	130	130	1367	1367	1367	1538	923	615	1722	1722	143	143	130	130	130			
Maintenance - Low Rate ($)		357	357	357	167	76	76	76	615	615	615	1025	513	513	775	775	76	76	76	76	76			
Depreciation - High ($/h)		462	164	63	66	39	12	6	51	22	1	229	122	41	87	62	21	1	85	20	20			
Depreciation - Low ($/h)		164	70	21	23	13	3	2	14	6	0	69	40	5	32	19	6	0	21	10	10			
Depreciation - High ($/ac)		20.56	7.01	2.80	3.00	1.76	0.53	0.26	2.85	1.22	0.08	11.39	6.10	2.03	3.23	1.94	1.40	0.09	3.69	0.91	0.91			
Depreciation - Low ($/ac)		10.28	4.67	1.40	1.50	0.69	0.21	0.11	1.42	0.61	0.00	5.69	4.97	0.41	1.91	0.97	0.70	0.00	1.42	0.67	0.67			
Depreciation - Low ($/ac)																			21	5	2			
Finance Costs - High Rate ($/h)		158	51	25	0	19	5	0	26	4	0	80	41	8	44	28	11	0	11	3	1			
Finance Costs - Low Rate ($/h)		54	18	8	0	7	2	0	7	1	0	24	12	2	18	10	2	0	11	3	1			
Finance Costs - High Rate ($/ac)		7.20	2.34	1.12	0.00	0.88	0.21	0.00	1.42	0.24	0.00	3.98	2.03	0.41	1.61	0.97	0.70	0.00	0.97	0.23	0.09			
Finance Costs - Low Rate ($/ac)		3.60	1.17	0.56	0.00	0.44	0.11	0.00	0.71	0.12	0.00	1.99	1.02	0.20	0.81	0.48	0.35	0.00	0.71	0.17	0.07			
Maintenance Cost - High Rate ($/ac)		0.68	0.68	0.68	0.45	0.23	0.23	0.23	1.11	1.11	1.11	1.25	0.75	0.50	1.11	1.11	0.13	0.13	0.23	0.23	0.23			
Maintenance Cost - Low Rate ($/ac)		0.33	0.33	0.33	0.33	0.13	0.13	0.13	0.50	0.50	0.50	0.83	0.42	0.42	0.50	0.50	0.07	0.07	0.13	0.13	0.13			
Labour Cost - High Rate ($/ac)		0.68	0.68	0.68	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Labour Cost - Low Rate ($/ac)		1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00			
Operating Costs - High Rate ($/h)		44.94	44.95	44.95	44.85	5.00	5.00	5.00	30.00	20.00	20.00	25.00	15.00	10.00	30.00	30.00	2.00	2.00	30.75	30.75	30.75			
Operating Costs - Low Rate ($/h)		28.00	28.00	28.00	28.00	2.00	2.00	2.00	5.00	5.00	5.00	10.00	5.00	5.00	10.00	10.00	2.00	2.00	5.00	5.00	5.00			
Operating Costs - High Rates ($/ac)		2.04	2.04	2.04	2.04	0.33	0.23	0.23	1.11	1.11	1.11	1.25	0.75	0.50	1.11	1.11	0.13	0.13	1.60	1.60	1.60			
Operating Costs - Low Rates ($/ac)		1.77	1.77	1.77	1.90	0.13	0.13	0.13	0.50	0.50	0.50	0.83	0.42	0.42	0.50	0.50	0.07	0.07	1.70	1.70	1.70			
Owning & Operating Costs - High Rates ($/h)		609.69	289.59	191.31	110.85	62.69	21.21	10.79	66.63	46.34	21.48	332.32	177.69	68.76	169.69	169.59	23.54	3.40	143.69	61.25	58.35			
Owning & Operating Cost - Low Rates ($/h)		234.69	114.12	68.04	61.60	21.74	6.74	3.68	28.34	12.32	6.00	102.35	66.66	12.32	68.30	38.00	7.06	0.00	68.63	39.36	37.76			
Owning & Operating Costs - High Rates ($/ac)		29.69	11.39	5.97	5.63	2.86	0.96	0.49	5.38	2.67	1.10	16.62	8.88	3.04	5.65	4.01	2.24	0.33	8.49	2.76	2.86			
Owning & Operating Cost - Low Rates ($/ac)		10.05	7.91	2.73	3.40	1.40	0.48	0.24	2.65	1.35	0.60	6.82	6.00	1.69	2.60	1.80	1.12	0.07	3.91	2.42	2.42			
Gross Value Grain Crop ($)		360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550			
Cost of Crop Production $		324840	324840	324840	324840	324840	324840	324840	324840	324840	324840	324840	324840	324840	324840	324840	324640	324640	324640	324640	324640			
Value of Grain Loss (Method) - High Rate ($)		4736	4736	4736	2213	2523	2523	2523	5068	5068	5068	4054	4054	4054	11890	11890	3157	3157	0	0	0			
Value of Grain Lose (Method) - Low Rate ($)		789	789	789	369	420	420	420	2027	2027	2027	1014	1014	1014	7014	7014	316	316	0	0	0			
Crop Value - High Rate of Operating Cost ($/ac)		27.09	27.09	27.09	66.37	60.36	60.36	60.36	23.69	23.69	23.69	24.66	26.15	25.40	17.03	17.03	39.48	39.48	61.36	61.36	61.36			
Crop Value - Low Rate of Operating Cost ($/ac)		32.62	32.62	32.62	71.09	62.26	62.26	62.26	27.95	27.65	27.65	29.37	29.37	29.37	18.64	18.64	33.27	33.27	63.06	63.06	63.06			
Crop Value - Operating & Ownership Cost - High Rates ($/ac)		-0.97	17.75	20.17	62.37	58.72	57.61	58.69	19.70	22.80	23.49	9.39	17.02	22.96	12.69	14.63	29.37	39.39	59.52	59.22	60.36			
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)		17.15	25.37	29.99	67.69	60.61	61.61	62.02	24.91	26.30	27.84	19.85	22.97	27.34	15.72	16.99	32.14	33.16	58.06	60.78	60.46			

1B. Harvesting Equipment

SYSTEM 1
SYSTEM 2

Ownership Costs																			
Total Cost of ownership - High Rate ($/year)	112,000	94,500	78,000	62,500	38,000	27,000	12,000	5,500	4,500	1,400	600	15,000	6,000	40,500	25,000	12,350	4,550	1,600	
Total Cost of ownership Low Rate ($/year)	76,000	64,750	54,000	43,750	24,000	17,250	6,000	2,750	2,250	600	250	7,500	3,000	26,250	7,500	7,500	2,275	450	
Operating Parameters																			
Variable Input Operating Costs																			
Fuel Price ($/L)	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0	0	0	0	0	0.65	0.65	0.65	0.65	0.65	
Operating Cost																			
Total ($) - High Rate	7,957	7,057	6,717	6,210	7,794	8,668	9,458	11,365	1,917	2,300	2,875	4,500	4,600	11,256	10,733	10,563	10,563	10,223	
Total ($) - Low Rate	6,587	6,587	6,086	10,110	9,456	9,456	10,925	14,567	1,438	1,917	2,300	1,917	1,917	14,663	13,728	15,142	13,696	12,630	
Calculated Cost Rates																			
Fuel Cost - High Rate ($/h)	32.50	32.50	29.25	29.25	26.00	22.75	19.50	19.50	0.00	0.00	0.00	0.00	0.00	29.25	26.00	22.75	22.75	19.50	
Fuel Cost - Low Rate ($/h)	26.00	26.00	22.75	22.75	19.50	16.25	13.00	13.00	0.00	0.00	0.00	0.00	0.00	26.00	22.75	19.50	19.25	13.00	
Fuel Cost - High Rate ($/ac)	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.00	0.00	0.00	0.00	0.00	0.65	0.65	0.65	0.65	0.65	
Fuel Cost - Low Rate ($/ac)	1.73	1.73	1.52	1.90	1.63	1.63	1.63	2.17	0.00	0.00	0.00	0.00	0.00	3.25	2.94	3.25	2.71	2.17	
Operating Costs - High Rate ($/h)	57.50	57.50	54.25	54.25	53.00	52.75	49.50	49.50	0.00	0.00	0.00	0.00	0.00	55.25	55.00	52.75	52.75	49.50	
Operating Costs - Low Rate ($/h)	56.00	56.00	52.75	52.75	49.50	41.25	39.00	39.00	0.00	0.00	0.00	0.00	0.00	54.00	52.75	49.50	49.25	39.00	
Operating Costs - High Rates ($/ac)	3.73	3.73	3.52	4.40	4.13	4.13	4.79	5.67	0.00	0.00	0.00	0.00	0.00	6.44	6.07	6.40	5.86	5.32	
Operating Costs - Low Rates ($/ac)	3.63	3.63	3.42	4.30	4.13	3.44	4.06	5.07	0.00	0.00	0.00	0.00	0.00	6.30	5.82	6.01	5.47	4.55	
Owning & Operating - High Rates ($/harv)	119,057	101,557	84,717	78,710	45,794	35,668	21,458	16,865	6,417	3,700	3,475	19,500	10,600	37,731	29,988	22,845	15,215	12,305	
Owning & Operating - Low Rates ($/harv)	84,587	73,337	62,086	53,860	33,456	26,736	16,925	17,317	3,688	2,517	2,550	9,417	4,917	34,088	21,353	22,102	15,256	13,513	
Owning & Operating Costs - High Rates ($/h)	1132.50	971.41	810.34	553.38	294.25	228.64	142.71	73.41	19.48	10.00	7.00	28.22	14.00	194.25	150.00	97.50	47.50	32.00	
Owning & Operating Cost - Low Rates ($/h)	581.65	476.28	404.90	381.01	174.73	116.25	58.87	44.71	12.00	6.57	5.94	14.47	7.00	167.50	107.50	94.72	47.50	35.00	
Owning & Operating Costs - High Rates ($/ac)	51.76	44.16	36.83	26.34	13.41	10.24	6.34	3.34	0.79	0.41	0.31	1.15	0.57	8.00	6.25	4.06	1.98	1.33	
Owning & Operating Cost - Low Rates ($/ac)	26.78	21.94	20.06	20.43	14.56	11.62	7.06	7.53	1.56	1.04	1.11	4.06	2.14	14.81	9.72	11.06	7.44	5.90	
Crop Value																			
Crop Value - Production and High Loss($)	17,883	17,883	17,883	17,883	17,883	17,883	17,883	17,883	31,175	31,175	31,175	25,994	25,994	35,910	35,910	35,910	35,910	35,910	
Crop Value - Production and Low Loss($)	32,305	32,305	32,305	32,305	32,305	32,305	32,305	32,305	34,332	34,332	34,332	32,305	32,305	35,910	35,910	35,910	35,910	35,910	
Crop Value - High Rate of Operating Costs ($)	10,826	10,826	11,165	9,673	10,088	9,794	9,305	6,498	29,258	28,875	28,300	20,494	20,494	24,554	25,177	24,928	24,925	25,675	
Crop Value - Low Rate of Operating Cost ($)	23,718	23,718	24,216	22,184	22,617	22,617	21,380	17,738	32,894	32,415	32,032	30,388	30,388	21,246	22,182	20,766	22,014	23,260	
Crop Value - High Rate of Operating Cost ($/ac)	4.71	4.71	4.85	4.21	4.39	4.26	4.05	2.83	12.72	12.56	12.31	8.91	8.91	10.68	10.95	10.84	10.84	11.16	
Crop Value - Low Rate of Operating Cost ($/ac)	10.31	10.31	10.53	9.65	9.84	9.84	9.30	7.71	14.30	14.10	13.93	13.21	13.21	9.24	9.65	9.03	9.57	10.11	
Crop Value - Op. & Own Cost - High Rates($)	-101,174	-83,674	-66,835	-52,827	-27,912	-17,206	-3,605	998	24,758	27,475	27,700	5,494	14,494	-1,321	6,010	13,566	19,695	23,605	
Crop Value - Op. & Own Cost - Low Rates ($)	-52,282	-41,032	-29,784	-21,556	-1,163	5,567	15,380	14,988	30,644	31,815	31,782	22,888	27,388	1,841	13,557	8,808	17,654	22,396	
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	-42.99	-35.56	-28.39	-22.44	-11.86	-7.31	-1.53	0.42	10.52	11.68	11.77	2.33	6.16	-0.56	2.55	5.77	8.37	10.03	
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	-22.23	-17.43	-12.65	-9.16	-0.49	2.37	6.54	6.37	13.02	13.52	13.50	9.73	11.64	0.78	5.76	3.74	7.50	9.52	

1B Harvesting Equipment

Enter number (1,2,3 etc) for # of machines selected for each system in box above machine column (1a, 2b etc.)																				
	SYSTEM 1						1					1						1		
	SYSTEM 2						1					1						1		
		1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	3a	3b	4a	4b	4c	4d	4e
Option			1								2		3				4			
Machine Name					Combine - SP						Combine - PT		Combine - McLeod				Tractor			
Selection		1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	3a	3b	4a	4b	4c	4d	4e
Machine Value ($)		400,000	350,000	300,000	250,000	200,000	150,000	100,000	50,000	30,000	20,000	10,000	100,000	50,000	150,000	100,000	65,000	35,000	15,000
Portion of Investment Financed (%)		80	70	60	50	40	30	20	10	50	20	10	50	20	70	50	40	30	20
Financing Charges - High (%)		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Financing Charges - Low (%)		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Depreciation Rate - High (%)		20	20	20	20	15	15	10	10	10	5	5	10	10	20	20	15	10	10
Depreciation Rate - Low (%)		15	15	15	15	10	10	5	5	5	2	2	5	5	10	5	10	5	2
Financing Cost - High Rate ($/year)		32,000	24,500	18,000	12,500	8,000	4,500	2,000	500	1,500	400	100	5,000	1,000	10,500	5,000	2,600	1,050	300
Financing Cost - Low Rate ($/year)		16,000	12,250	9,000	6,250	4,000	2,250	1,000	250	750	200	50	2,500	500	5,250	2,500	1,300	525	150
Depreciation - High Rate ($/year)		80,000	70,000	60,000	50,000	30,000	22,500	10,000	5,000	3,000	1,000	500	10,000	5,000	30,000	20,000	9,750	3,500	1,500
Depreciation - Low Rate ($/year)		60,000	52,500	45,000	37,500	20,000	15,000	5,000	2,500	1,500	400	200	5,000	2,500	15,000	5,000	6,500	1,750	300
Total Crop Area for Farm (ac)		2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
Area of Crop Windrowed		1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
Area of Crop Direct Cut		1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230				1,230	1,230					1,230
Area of Crop Swaped		1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550						1,550	1,550	1,550	1,550	1,550
Use - Area of crop per year (ac)		2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300
Operating Time - Higher Work Rate (h)		105	105	105	128	128	153	192	230	192	230	288	230	230	192	192	230	230	230
Operating Time - Lower Work Rate (h)		153	153	153	192	192	230	288	383	288	383	460	383	383	288	288	383	383	383
Hours of Use for Year															300	250	250	200	200
Fuel Use Rate- High (L/h)		50	50	45	45	40	35	30	30	0	0	0	0	0	45	40	35	35	30
Fuel Use Rate - Low (L/h)		40	40	35	35	30	25	20	20	0	0	0	0	0	40	35	30	25	20
Loss - High (% of yield)		5	5	5	5	5	5	5	5	3	3	3	3	3	0	0	0	0	0
Loss - Low (% of yield)		1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Work Rate Rate - Higher (ac/h)		22	22	22	18	18	15	12	10	12	10	8	10	10	12	12	10	10	10
Work Rate - Lower (ac/h)		16	16	16	12	12	10	8	6	8	6	5	6	6	8	8	6	6	6
Operator Labour Rate ($/h)		15	15	15	15	15	15	15	15	0	0	0	0	0	15	15	15	15	15
Maintenance Cost Estimate - High Rate($/h)		20	20	20	20	20	15	15	15	10	10	10	20	20	15	15	10	10	10
Maintenance Cost Estimate - Low Rate ($/h)		15	15	15	15	15	10	10	10	5	5	5	5	5	10	10	5	5	5
Cost of fuel - High Rate ($)		3398	3398	3058	3738	3322	3498	3738	4485	0	0	0	0	0	5606	4983	5233	5233	4485
Cost of fuel - Low Rate ($)		2987	2987	2488	4360	3738	3738	3738	4983	0	0	0	0	0	7475	6541	7475	6229	4983
Cost of Labour - High Rate($)		1568	1568	1568	1917	1917	2300	2875	3450	0	0	0	0	0	2875	2875	3450	3450	3450
Cost of Labour - Low Rate ($)		2300	2300	2300	2875	2875	3450	4313	5750	0	0	0	0	0	4313	4313	5750	5750	5750
Maintenance - High Rate ($)		2091	2091	2091	2556	2556	2300	2875	3450	1917	2300	2875	4600	4600	2875	2875	2300	2300	2300
Maintenance - Low Rate ($)		2300	2300	2300	2875	2875	2300	2875	3833	1438	1917	2300	1917	1917	2875	2875	1917	1917	1917
Depreciation - High ($/h)		768	670	574	391	235	147	52	22	16	4	2	43	22	100	80	39	18	8
Depreciation - Low ($/h)		391	342	280	196	104	66	17	7	5	1	0	13	7	66	20	25	9	2
Depreciation - High ($/ac)		34.78	30.43	26.09	21.74	13.04	9.78	4.35	2.17	1.30	0.43	0.22	4.35	2.17	0.33	0.67	3.90	1.75	0.75
Depreciation - Low ($/ac)		26.09	22.83	19.57	16.30	8.70	6.52	2.17	1.09	0.65	0.17	0.09	2.17	1.09	0.26	2.50	4.33	1.46	0.25
Finance Costs - High Rate ($/h)		306	234	172	98	63	29	10	2	8	2	0	22	4	35	20	10	5	2
Finance Costs - Low Rate ($/h)		104	80	59	33	21	10	3	1	3	1	0	7	1	18	10	5	3	1
Finance Costs - High Rate ($/ac)		13.91	10.65	7.83	5.43	3.48	1.98	0.87	0.22	0.65	0.17	0.04	2.17	0.43	2.92	1.67	1.04	0.53	0.15
Finance Costs - Low Rate ($/ac)		6.96	5.33	3.91	2.72	1.74	0.98	0.43	0.11	0.33	0.09	0.02	1.09	0.22	2.19	1.25	0.87	0.44	0.13
Maintenance Cost - High Rate ($/ac)		0.91	0.91	0.91	1.11	1.11	1.00	1.25	1.50	0.83	1.00	1.25	2.00	2.00	1.25	1.25	1.00	1.00	1.00
Maintenance Cost - Low Rate ($/ac)		1.00	1.00	1.00	1.25	1.25	1.00	1.25	1.67	0.63	0.83	1.00	0.83	0.83	1.25	1.25	0.83	0.83	0.83
Labour Cost - High Rate ($/ac)		0.68	0.68	0.68	0.83	0.83	1.00	1.25	1.50	0.00	0.00	0.00	0.00	0.00	1.25	1.25	1.50	1.50	1.50
Labour Cost - Low Rate ($/ac)		1.00	1.00	1.00	1.25	1.25	1.50	1.88	2.50	0.00	0.00	0.00	0.00	0.00	1.00	1.00	2.50	2.50	2.50
Operating Costs - High Rate ($/h)		67.50	67.50	64.25	64.25	61.00	52.75	46.00	46.00	10.00	10.00	10.00	8.00	8.00	68.35	65.00	47.75	47.75	44.50
Operating Costs - Low Rate ($/h)		58.00	58.00	52.75	52.75	49.50	41.25	38.00	38.00	5.00	5.00	5.00	5.00	5.00	51.50	47.75	38.00	38.25	33.00
Operating Costs - High Rates ($/ac)		3.97	3.97	2.92	3.97	3.39	3.02	4.13	4.96	0.83	1.00	1.25	2.00	2.00	4.94	4.97	4.78	4.78	4.45
Operating Costs - Low Rates ($/ac)		3.73	3.73	3.02	4.49	4.13	4.13	4.75	6.33	0.63	0.83	1.00	0.83	0.83	6.38	5.97	6.59	6.04	5.88
Owning & Operating Costs - High Rates ($/h)		1138.80	971.41	810.34	683.30	388.39	228.84	112.11	73.41	33.48	16.69	12.69	86.22	46.69	184.35	168.00	97.15	70.69	53.69
Owning & Operating Cost - Low Rates ($/h)		891.68	479.38	404.82	281.91	174.72	118.38	59.67	46.17	12.63	6.67	5.04	34.67	12.85	118.88	77.75	78.70	47.83	36.26
Owning & Operating Costs - High Rates ($/ac)		91.78	44.18	36.83	28.74	18.91	15.26	9.34	7.34	2.79	1.91	1.91	9.92	4.81	16.19	13.69	9.72	7.06	5.35
Owning & Operating Cost - Low Rates ($/ac)		30.78	31.80	26.89	23.42	14.88	11.65	7.39	7.53	1.66	1.06	1.11	4.69	2.14	14.81	9.72	11.70	7.04	5.88
Gross Value Grain Crop Based Upon Method ($)		380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550	380550
Cost of Crop Production $		324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640
Value of Grain Loss - High Rate ($)		18028	18028	18028	18028	18028	18028	18028	18028	4736	4736	4736	10817	10817	0	0	0	0	0
Value of Grain Loss - Low Rate ($)		3606	3606	3606	3606	3606	3606	3606	3606	1579	1579	1579	3606	3606	0	0	0	0	0
Crop Value - High Rate of Operating Cost ($/ac)		4.71	4.71	4.66	4.21	4.39	4.39	3.65	2.83	12.72	12.55	12.30	8.01	8.01	10.66	10.65	10.04	10.04	11.18
Crop Value - Low Rate of Operating Cost ($/ac)		14.05	14.05	14.05	14.05	14.05	14.06	14.06	14.06	14.83	14.83	14.83	14.05	14.05	15.61	15.61	15.61	15.61	15.61
Crop Value - Operating & Ownership Cost - High Rates ($/ac)		-43.89	-36.36	-28.06	-22.97	-12.14	-7.48	-1.67	0.43	10.76	11.86	12.04	2.39	6.30	-0.67	2.61	5.66	8.56	10.29
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)		-20.78	-17.84	-12.96	-9.37	-0.51	2.42	6.68	6.92	13.32	13.93	13.92	9.96	11.91	0.98	5.99	3.83	7.68	9.74

1C : Grain Handling

SYSTEM 1
SYSTEM 2

Ownership Costs																		
Total Cost of ownership - High Rate ($/year)	40,700	27,750	12,500	7,500	2,400	1,100	24,500	8,600	8,050	500	150	32,500	27,500	18,750	7,605	1,650	32,500	25,000
Total Cost of ownership Low Rate ($/year)	25,850	17,625	6,250	3,750	1,200	550	15,750	4,400	4,025	375	0	33,750	18,750	6,375	3,500	375	33,750	12,500
Operating Parameters																		
Variable Input Operating Costs																		
Fuel Price ($/L)	1.00	1.00	1.00	1.00	0.75	1.00	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	1	1
Operating Cost																		
Total ($) - High Rate	6,240	6,240	5,931	6,023	6,529	9,879	575	787	261	460	1,333	5,260	5,260	5,197	5,954	630	4,800	5,750
Total ($) - Low Rate	7,360	7,360	6,840	6,840	8,355	9,416	587	466	85	121	573	5,627	5,627	5,540	6,643	539	2,399	5,875
Calculated Cost Rates																		
Fuel Cost - High Rate ($/h)	14.50	14.50	14.50	14.50	14.50	23.50	2.00	2.00	3.00	3.00	3.00	12.00	12.00	12.00	12.00	9.00	2.00	2.00
Fuel Cost - Low Rate ($/h)	9.75	9.75	9.75	9.75	9.75	12.75	2.00	2.00	3.00	3.00	3.00	12.00	12.00	12.00	12.00	9.00	2.00	2.00
Fuel Cost - High Rate ($/t)	0.58	0.60	0.58	0.58	0.65	0.95	0.80	0.80	0.60	0.60	0.60	2.40	2.40	2.40	2.40	1.80	0.80	0.80
Fuel Cost - Low Rate ($/t)	0.98	1.00	0.98	0.98	1.02	1.28	0.80	0.80	0.60	0.60	0.60	2.40	2.40	2.40	2.40	1.80	0.80	0.80
Operating Cost - High Rate ($/h)	34.50	34.50	33.00	33.00	34.50	50.50	3.00	3.00	10.00	10.00	10.00	38.00	38.00	38.00	38.00	28.00	3.00	3.00
Operating Cost - Low Rate ($/h)	34.50	34.50	29.00	29.00	29.00	32.00	3.00	3.00	10.00	10.00	10.00	38.00	38.00	38.00	38.00	28.00	3.00	3.00
Operating Cost - High Rate ($/t)	1.38	1.40	1.38	1.38	1.71	2.53	1.20	1.20	1.00	1.00	1.00	7.60	7.60	7.60	7.60	5.60	1.20	1.20
Owning & Operating - High Rates ($/hr)	10,940	9,459	9,206	9,696	9,678	10,206	14,663	7,513	662	850	1,572	41,725	29,643	17,940	10,669	935	57,100	30,750
Owning & Operating - Low Rates ($/hr)	13,938	12,046	10,456	8,999	9,416	9,811	12,382	5,520	350	346	575	23,977	15,410	11,920	9,539	791	36,050	15,271
Owning & Operating Costs - High Rates ($/h)	85.00	83.25	80.75	80.75	80.75	97.00	6.00	4.80	10.00	10.00	10.00	50.00	50.00	50.00	50.00	37.00	4.00	4.00
Owning & Operating Costs - Low Rates ($/h)	85.00	83.25	80.75	80.75	80.75	94.00	6.00	4.80	10.00	10.00	10.00	50.00	50.00	50.00	50.00	37.00	4.00	4.00
Owning & Operating Costs - High Rates ($/t)	4.75	4.77	4.64	4.67	4.99	6.53	1.60	1.60	1.00	1.00	1.00	10.00	10.00	10.00	10.00	7.40	1.60	1.60
Owning & Operating Costs - Low Rates ($/t)	6.05	5.84	5.44	5.47	5.99	6.27	1.60	1.60	1.00	1.00	1.00	10.00	10.00	10.00	10.00	7.40	1.60	1.60
Crop Value																		
Crop Value - Production and High Loss ($)	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910
Crop Value - Production and Low Loss ($)	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910	35,910
Crop Value - High Rate of Operating Costs ($)	29,643	29,643	30,218	29,987	27,381	26,231	35,335	35,143	35,640	35,510	34,377	29,643	29,643	27,553	28,818	35,685	31,318	30,160
Crop Value - Low Rate of Operating Cost ($)	27,918	27,918	29,068	29,068	27,357	26,484	35,603	35,450	35,625	35,780	35,335	30,983	30,983	27,170	29,068	35,190	33,618	33,835
Crop Value - High Rate of Operating Cost ($/a)	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.00
Crop Value - Low Rate of Operating Cost ($/a)	67.00	67.00	69.75	69.75	65.65	63.56	85.45	85.08	85.50	85.87	84.80	74.36	74.36	65.21	69.75	84.46	80.68	81.20
Crop Value - Op. & Own Cost - High Rates ($)	24,962	26,451	26,624	26,212	26,231	25,704	21,248	28,397	35,228	35,060	34,336	-5,816	15,268	17,970	25,241	34,975	-21,190	5,160
Crop Value - Op. & Own Cost - Low Rates ($)	21,972	23,664	25,474	26,911	26,494	26,099	23,528	30,390	35,551	35,562	35,335	-12,633	20,566	19,563	26,564	35,159	-140	20,333
Crop Value - Operating & Ownership Cost - High Rates ($/a)	123	135	136	134	134	131	109	145	180	179	175	-30	78	92	129	179	-108	26
Crop Value - Operating & Ownership Cost - Low Rates ($/a)	112	121	130	137	135	133	120	155	182	182	180	-64	105	100	136	180	-1	104

1C - Grain Handling

Enter number (1,2,3 etc.) for # of machines selected for each system or box above machine selection (1a, 2b etc.)	SYSTEM 1			1							1						1		
	SYSTEM 2			0							0						0		
		1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	4d	4e	5a	5b
System		1						2		3			4					5	
Machine Name		Grain Truck on Basic Tractor Trailer						Grain Cart		Grain Auger			Tractor					Unload McLeod	
Selection		1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	4d	4e	5a	5b
Machine Value ($)		110,000	75,000	50,000	30,000	20,000	10000	70,000	40,000	30,000	15,000	5000	250,000	150,000	75,000	50,000	15,000	150,000	100,000
Portion of Investment Financed (%)		70	70	50	50	20	10	50	20	30	10	0	70	50	50	40	10	50	50
Financing Charges - High (%)		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Financing Charges - Low (%)		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Depreciation Rate - High (%)		20	20	20	20	10	10	20	10	20	5	2	20	20	20	10	10	20	20
Depreciation Rate - Low (%)		20	20	10	10	5	5	20	10	10	2	0	10	10	10	5	2	20	10
Financing Cost - High Rate ($/year)		7,700	5,250	2,500	1,500	400	100	3,500	800	1,000	100	0	17,500	7,500	3,750	2,000	150	7,500	5,000
Financing Cost - Low Rate ($/year)		3,850	2,625	1,250	750	200	50	1,750	400	525	75	0	8,750	3,750	1,875	1,000	75	3,750	2,500
Depreciation - High Rate ($/year)		35,000	22,000	10,000	6,000	2,000	1,000	21,000	8,000	7,000	700	100	75,000	30,000	15,000	5,000	1,500	45,000	26,000
Depreciation - Low Rate ($/year)		22,000	15,000	5,000	3,000	1,000	500	14,000	4,000	5,000	300	0	25,000	15,000	7,500	2,500	300	30,000	10,000
Total Crop Area for Farm (ac)		2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
Area of Crop Windrowed		1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
Area of Crop Direct Cut		1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,070	1,230	1,230	1,230
Area of Crop Stripped		1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560
Less - Area of crop per year (ac)		2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300
Operating Time - High Work Rate (h)		115	115	115	153	192	192	115	153	13	20	77	115	115	153	153	20	153	192
Operating Time - Lower Work Rate (h)		230	230	230	230	288	288	153	230	17	24	115	153	153	230	230	24	230	288
Hours of Use for Year		1000	1000	460	460	480	480	200	200	200	40	200	200	200	200	200	200	0	0
Fuel Use Rate- High (L/h)		30	30	30	30	30	30	0	0	0	0	10	30	30	30	20	20	0	0
Fuel Use Rate - Low (L/h)		15	15	15	15	15	15	0	0	0	0	5	20	20	20	15	15	0	0
Loss - High (% of yield)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5
Loss - Low (% of yield)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work Rate Rate - Higher (ac/h)		20	20	20	15	12	12	20	15	178	115	30	20	20	15	15	115	15	12
Work Rate - Lower (ac/h)		10	10	10	10	8	8	15	10	125	85	20	15	15	10	10	85	10	8
Operator Labour Rate ($/h)		15	15	15	15	15	15	0	0	0	0	0	15	15	15	15	15	0	0
Maintenance Cost Estimate - High Rate($/h)		20	20	15	10	10	10	5	5	20	20	20	20	20	20	15	10	30	30
Maintenance Cost Estimate - Low Rate ($/h)		10	10	5	5	5	5	2	2	5	5	5	10	10	10	5	5	10	10
Cost of fuel - High Rate ($)		2243	2243	2243	2990	3736	4599	0	0	0	0	0	2243	2243	2990	2492	325	0	0
Cost of fuel - Low Rate ($)		2243	2243	2243	2243	2803	3699	0	0	0	0	0	1950	1950	2990	2243	299	0	0
Cost of Labour - High Rate($)		1725	1725	1725	2300	2875	2875	0	0	0	0	0	1725	1725	2300	2300	300	0	0
Cost of Labour - Low Rate ($)		3450	3450	3450	3450	4313	4313	0	0	0	0	0	2300	2300	3450	3450	300	0	0
Maintenance - High Rate ($)		2300	2300	1725	1533	1917	1917	575	767	251	400	1533	2300	2300	3067	2300	200	4500	5750
Maintenance - Low Rate ($)		2300	2300	1150	1150	1438	1438	307	460	65	121	575	1533	1533	2300	1150	121	2300	2875
Depreciation - High ($/h)		20	20	20	10	5	5	100	40	20	10	1	200	100	60	17	5	200	104
Depreciation - Low ($/h)		20	10	10	5	2	1	70	20	10	0	0	60	60	20	5	1	130	35
Depreciation - High ($/ac)		1.66	1.13	1.25	1.00	0.42	0.21	5.25	2.67	0.10	0.10	0.02	12.99	6.09	3.75	1.11	0.04	19.97	6.70
Depreciation - High ($/ac)		2.59	1.98	1.25	0.75	0.31	0.16	4.67	2.09	0.10	0.03	0.00	5.85	3.33	2.60	0.52	0.01	13.04	4.35
Operation - Low ($/ac)		2.59	1.98	1.25	0.75	0.31	0.16	4.67	2.09	0.10	0.03	0.00	5.85	3.33	2.60	0.52	0.01	13.04	26.09
Finance Costs - High Rate ($/h)		7.70	5.25	6.25	3.75	1.00	0.25	17.50	4.00	4.20	3.75	0.50	50.33	25.00	12.50	5.67	0.50	16.30	8.70
Finance Costs - Low Rate ($/h)		3.85	2.63	3.13	1.88	0.50	0.13	8.75	2.00	2.10	1.88	0.25	29.17	12.50	6.25	3.33	0.25	3.25	2.17
Finance Costs - High Rate ($/ac)		0.39	0.28	0.31	0.25	0.08	0.02	0.88	0.27	0.02	0.03	0.00	2.92	1.25	0.63	0.44	0.05	1.63	1.09
Finance Costs - Low Rate ($/ac)		0.39	0.28	0.31	0.19	0.05	0.02	0.88	0.29	0.02	0.02	0.00	1.84	0.83	0.63	0.33	0.05	1.63	0.54
Maintenance Cost - High Rate ($/ac)		1.00	1.00	0.75	0.67	0.83	0.83	0.25	0.33	0.11	0.17	0.67	1.00	1.00	1.33	1.00	0.09	2.35	2.50
Maintenance Cost - Low Rate ($/ac)		1.00	1.00	0.50	0.50	0.63	0.63	0.13	0.20	0.04	0.05	0.25	0.67	0.67	1.00	0.50	0.05	1.50	1.25
Labour Cost - High Rate ($/ac)		0.75	0.75	0.75	1.00	1.25	1.25	0.00	0.00	0.00	0.00	0.00	0.75	0.75	1.00	1.00	0.13	0.00	0.00
Labour Cost - Low Rate ($/ac)		1.50	1.50	1.50	1.50	1.88	1.88	0.00	0.00	0.00	0.00	0.00	1.50	1.50	1.50	1.50	0.19	0.00	0.00
Operating Costs - High Rate ($/ac)		54.59	54.59	49.59	44.59	44.59	22.59	5.00	5.00	20.00	20.00	20.00	64.59	64.59	64.59	49.59	44.59	32.59	39.59
Operating Costs - Low Rate ($/h)		34.79	34.79	29.79	29.79	29.79	12.79	2.00	2.00	9.00	9.00	9.00	39.79	39.79	39.79	29.79	29.79	19.59	19.59
Operating Costs - High Rates ($/ac)		2.73	2.73	2.48	2.97	3.71	4.31	0.25	0.33	0.11	0.17	0.67	3.13	2.73	3.67	2.98	0.31	1.63	1.25
Operating Costs - Low Rates ($/ac)		3.48	3.48	2.98	2.98	3.72	4.49	0.13	0.20	0.04	0.06	0.30	2.98	2.98	3.98	2.98	0.31	1.63	1.30
Owning & Operating Costs - High Rates ($/h)		65.29	62.25	59.75	49.25	59.83	59.25	127.69	49.69	62.29	42.69	25.69	262.63	175.63	117.69	69.69	48.75	272.39	160.43
Owning & Operating Costs - Low Rates ($/h)		49.60	48.39	45.39	39.13	33.75	26.13	69.75	24.69	21.10	14.69	5.69	169.38	100.38	69.25	41.45	31.69	169.75	83.46
Owning & Operating Costs - High Rates ($/ac)		4.79	4.11	4.04	4.22	4.21	4.44	6.38	2.27	0.33	0.37	0.69	10.10	6.80	7.00	4.64	0.47	14.48	13.37
Owning & Operating Cost - Low Rates ($/ac)		3.66	3.34	4.04	3.01	4.69	4.27	3.38	2.46	0.18	0.15	0.28	10.03	6.78	6.66	4.14	0.33	15.67	6.66
Gross Value Grain Crop Based Upon Method ($)		360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550
Cost of Crop Production $		324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640
Value of Grain Loss - High Rate ($)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1803	1803
Value of Grain Loss - Low Rate ($)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crop Value - High Rate of Operating Cost ($/ac)		12.69	12.69	13.14	12.69	11.69	11.49	15.38	15.38	15.69	15.44	14.85	12.69	12.69	11.69	12.69	15.24	13.69	13.11
Crop Value - Low Rate of Operating Cost ($/ac)		15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61	15.61
Crop Value - Operating & Ownership Cost - High Rates ($/ac)		15.69	11.69	11.69	11.49	11.49	11.16	8.94	12.36	15.32	15.24	14.85	2.69	6.89	7.91	10.67	15.21	4.21	2.24
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)		8.58	10.58	11.08	11.79	11.92	11.36	15.23	15.21	15.48	15.46	15.39	5.68	8.01	8.69	11.47	15.39	4.52	8.83

1D - Straw and Chaff

SYSTEM 1
SYSTEM 2

Ownership Costs																			
Total Cost of ownership - High Rate ($/year)	1,700	0	0	7,500	3,600	0	32,400	5,250	1,800	0	14,550	3,000	37,500	15,000	4,500	18,750	3,750	5,250	2,250
Total Cost of ownership Low Rate ($/year)	850	0	0	3,750	1,800	0	14,200	2,625	900	0	7,425	750	22,500	7,500	2,250	11,475	4,875	2,400	1,125
Operating Parameters																			
Variable Input Operating Costs																			
Operating Cost																			
Total ($) - High Rate	169	169	338	6450	6450	7490	1233	2700	2700	2700	1388	625	3443	3443	4402	3142	1742	3815	3948
Total ($) - Low Rate	169	169	338	6450	6450	10656	925	3883	3883	3883	1542	771	7930	7930	2315	3660	3664	3304	3904
Calculated Cost Rates																			
Fuel Cost - High Rate ($/h)	0.00	0.00	0.00	13.50	13.50	21.50	0.00	0.00	0.00	0.00	0.00	0.00	29.25	29.25	29.25	13.50	13.50	15.20	15.20
Fuel Cost - Low Rate ($/h)	0.00	0.00	0.00	6.75	6.75	12.75	0.00	0.00	0.00	0.00	0.00	0.00	14.63	14.63	14.63	6.75	6.75	7.60	7.60
Fuel Cost - High Rate ($/ac)	0.00	0.00	0.00	2.63	2.63	3.65	0.00	0.00	0.00	0.00	0.00	0.00	1.95	1.95	1.95	0.90	0.90	0.80	0.80
Fuel Cost - Low Rate ($/ac)	0.00	0.00	0.00	1.31	1.31	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.98	0.98	0.45	0.45	0.40	0.40
Operating Cost - High Rate ($/h)																			
Operating Cost - Low Rate ($/h)																			
Operating Cost - High Rate ($/ac)																			
Operating Cost - Low Rate ($/ac)																			
Owning & Operating - High Rates ($/Hr)	1,869	169	338	6,675	6,478	7,690	23,633	8,950	5,506	3,706	16,238	3,625	37,238	18,498	7,745	8,964	5,475	3,414	5,962
Owning & Operating - Low Rates ($/Hr)	1,019	169	338	10,965	8,631	16,656	17,125	5,156	3,983	3,983	8,967	1,521	28,325	13,565	5,246	8,587	5,673	7,107	6,152
Owning & Operating - High Rates ($/h)																			
Owning & Operating - Low Rates ($/h)																			
Owning & Operating - High Rates ($/ac)																			
Owning & Operating - Low Rates ($/ac)																			
Crop Value																			
Crop Value - Production and High Loss ($)	6,130	6,130	6,130	6,130	6,130	6,130	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697
Crop Value - Production and Low Loss ($)	6,130	6,130	6,130	6,130	6,130	6,130	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697
Crop Value - High Rate of Operating Costs ($)	5,961	5,961	5,792	1,660	1,660	-1,560	20,464	17,997	17,997	17,997	20,310	20,772	15,754	15,754	17,295	17,955	17,955	17,561	16,470
Crop Value - Low Rate of Operating Cost ($)	5,961	5,961	5,792	-326	-326	-3,926	20,772	18,614	18,614	18,614	20,155	20,326	14,967	14,967	16,182	18,028	18,028	16,193	15,193
Crop Value - High Rate of Operating Cost ($/ac)																			
Crop Value - Low Rate of Operating Cost ($/ac)																			
Crop Value - Op. & Own Cost - High Rates ($)	4,261	5,961	5,792	-2,545	-345	-1,960	-11,936	12,747	16,197	17,997	5,460	17,772	-15,541	3,195	13,552	12,713	15,222	16,278	15,765
Crop Value - Op. & Own Cost - Low Rates ($)	5,111	5,961	5,792	-4,655	-2,501	-3,925	4,572	15,989	17,714	18,614	12,730	20,176	-6,628	6,112	16,451	13,310	16,024	14,596	15,515
Crop Value - Operating Cost - High Rate ($/ac)																			
Crop Value - Operating Cost - Low Rate ($/ac)																			

1D - Straw and Chaff

Enter number (1,2,3 etc.) for number of machines selected for each system in box above machine column (1a, 2b etc.)																				
SYSTEM 1																				
SYSTEM 2			1			1			1									1		
	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	5b	6c	6d	
Option	1			2			3				4		5			6				
Machine Name	Chaff Collector			Chaff Truck			Baler				Bale Mover		Semi Tractor Trailer			Tractor				
Selection	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d	
Machine Value ($)	10,000	6,000	3500	50,000	30,000	10,000	120,000	35,000	15,000	5000	55,000	25,000	100,000	60,000	30,000	85,000	65,000	40,000	20,000	
Portion of Investment Financed (%)	70	0	0	50	20	0	70	50	20	0	70	20	70	50	50	70	50	30	10	
Financing Charges - High (%)	10	10	10	10	10	0	10	10	10	0	10	10	10	10	10	10	10	10	10	
Financing Charges - Low (%)	5	5	5	5	5	0	5	5	5	0	5	5	5	5	5	5	5	5	5	
Depreciation Rate - High (%)	10	0	0	10	10	0	30	12	10	0	26	10	30	26	10	15	10	10	10	
Depreciation Rate - Low (%)	5	0	0	5	5	0	10	5	5	0	10	2	20	10	5	10	5	5	5	
Financing Cost - High Rate ($/year)	700	0	0	2,500	600	0	8,400	1,750	300	0	3,850	500	7,000	3,600	1,500	6,350	3,250	1,200	200	
Financing Cost - Low Rate ($/year)	350	0	0	1,250	300	0	4,200	875	150	0	1,925	250	3,500	1,500	750	2,975	1,625	600	100	
Depreciation - High Rate ($/year)	1,000	0	0	5,000	3,000	0	24,000	3,500	1,500	0	11,000	2,500	30,000	12,000	3,000	12,750	6,500	4,000	2,000	
Depreciation - Low Rate ($/year)	500	0	0	2,500	1,500	0	12,000	1,750	750	0	5,500	500	20,000	6,000	1,500	8,500	3,250	2,000	1,000	
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	
Area of Crop Windrowed	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	
Area of Crop Direct Cut	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	
Area of Crop Stripped	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	
Use - Area of crop per year (ac)	1690	1690	1690	1690	1690	1690	1850	1860	1860	1850	1850	1850	1860	1860	1860	1850	1850	1850	1850	
Operating Time - Higher Work Rate (h)	85	85	169	113	113	169	62	185	185	185	93	93	93	93	69	84	84	93	123	
Operating Time - Lower Work Rate (h)	169	169	338	241	241	338	93	308	308	308	154	154	185	185	93	123	123	185	185	
Hours of Use for Year				200	200	300							500	500	300	300	300	300	300	
Fuel Use Rate- High (L/h)	0	0	0	30	30	30	0	0	0	0	0	0	45	45	45	30	30	25	25	
Fuel Use Rate - Low (L/h)	0	0	0	15	15	15	0	0	0	0	0	0	20	20	20	15	15	15	15	
Loss - High (% of yield)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Loss - Low (% of yield)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Work Rate Rate - Higher (ac/h)	20	20	10	15	15	10	30	10	10	10	20	20	20	20	27	22	22	20	15	
Work Rate - Lower (ac/h)	10	10	5	7	7	5	20	6	6	6	12	12	10	10	20	15	15	10	10	
Operator Labour Rate ($/h)	0	0	0	15	15	15	0	0	0	0	0	0	15	15	15	15	15	15	15	
Maintenance Cost Estimate - High Rate($/h)	2	2	2	5	5	5	20	20	20	20	15	10	20	20	20	10	10	10	10	
Maintenance Cost Estimate - Low Rate ($/h)	1	1	1	2	2	2	10	10	10	10	10	5	10	10	10	5	5	5	5	
Cost of fuel - High Rate ($)	0	0	0	2197	2197	4310	0	0	0	0	0	0	2706	2706	2004	1640	1640	1503	2004	
Cost of fuel - Low Rate ($)	0	0	0	2354	2354	4310	0	0	0	0	0	0	2405	2405	1203	1203	1203	1804	1804	
Cost of Labour - High Rate ($)	0	0	0	1690	1690	2535	0	0	0	0	0	0	1388	1388	1028	1261	1261	1388	1850	
Cost of Labour - Low Rate ($)	0	0	0	3621	3621	5070	0	0	0	0	0	0	2775	2775	1388	1850	1850	2775	2775	
Maintenance - High Rate $)	169	169	338	563	563	845	1233	3700	3700	3700	1388	925	1850	1850	1370	841	841	925	1233	
Maintenance - Low Rate $)	169	169	338	483	483	676	925	3083	3083	3083	1542	771	1850	1850	925	617	617	925	925	
Depreciation - High ($/h)	12	0	0	25	15	0	360	10	6	0	110	27	324	130	44	43	22	13	7	
Depreciation - Low ($/h)	3	0	0	13	0	0	120	6	2	0	28	3	108	32	16	20	11	7	3	
Depreciation - High ($/ac)	0.59	0.00	0.00	1.67	1.00	0.00	12.97	1.89	0.81	0.00	5.95	1.35	16.22	6.49	1.62	1.93	0.96	0.67	0.44	
Depreciation - Low ($/ac)	0.29	0.00	0.00	1.79	1.07	0.00	12.97	1.89	0.81	0.00	2.97	0.27	10.81	3.24	0.81	1.89	0.72	0.67	0.33	
							0.48	0.00	0.41	0.00										
Finance Costs - High Rate ($/h)	6	0	0	13	3	0	136	9	2	0	42	5	14	6	5	20	11	4	1	
Finance Costs - Low Rate ($/h)	2	0	0	6	2	0	45	3	0	0	12	2	7	3	3	10	5	2	0	
Finance Costs - High Rate ($/ac)	0.41	0.00	0.00	0.83	0.20	0.00	4.54	0.95	0.16	0.00	2.08	0.27	0.70	0.30	0.19	0.90	0.49	0.20	0.04	
Finance Costs - Low Rate ($/ac)	0.21	0.00	0.00	0.89	0.21	0.00	2.27	0.47	0.08	0.00	1.04	0.14	0.70	0.30	0.13	0.66	0.36	0.20	0.03	
Maintenance Cost - High Rate ($/ac)	0.10	0.10	0.20	0.33	0.33	0.50	0.67	2.00	2.00	2.00	0.75	0.50	1.00	1.00	0.74	0.45	0.45	0.50	0.67	
Maintenance Cost - Low Rate ($/ac)	0.10	0.10	0.20	0.29	0.29	0.40	0.50	1.67	1.67	1.67	0.83	0.42	1.00	1.00	0.50	0.33	0.33	0.50	0.50	
Labour Cost - High Rate ($/ac)	0.00	0.00	0.00	1.00	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.75	0.56	0.66	0.66	0.75	1.00	
Labour Cost - Low Rate ($/ac)	0.00	0.00	0.00	2.14	2.14	3.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.75	1.00	1.00	1.50	1.50	
Operating Costs - High Rate ($/h)	2.00	2.00	2.00	39.00	39.00	45.00	30.00	30.00	30.00	30.00	10.00	10.00	64.35	64.35	64.35	44.80	44.80	41.35	41.35	
Operating Costs - Low Rate ($/h)	1.00	1.00	1.00	29.75	29.75	29.75	10.00	10.00	10.00	10.00	10.00	6.66	36.00	36.00	36.00	29.75	29.75	29.75	29.75	
Operating Costs - High Rate ($/ac)	0.19	0.19	0.20	2.60	2.60	4.50	0.67	2.00	2.00	2.00	0.75	0.50	3.21	3.21	2.38	2.02	2.02	2.06	2.76	
Operating Costs - Low Rates ($/ac)	0.10	0.10	0.20	3.62	3.62	5.95	0.50	1.67	1.67	1.67	0.83	0.42	3.60	3.60	1.50	1.96	1.98	2.96	2.96	
Owning & Operating Costs - High Rates ($/h)	22.12	2.60	2.60	77.00	57.00	45.50	545.41	48.38	29.73	30.00	175.54	42.43	402.57	189.86	113.03	106.03	77.00	55.69	46.59	
Owning & Operating Cost - Low Rates ($/h)	6.00	1.00	1.00	46.00	30.75	30.75	165.14	18.51	12.82	10.00	88.16	9.08	183.11	73.43	58.72	66.80	46.00	35.42	33.42	
Owning & Operating Costs - High Rates ($/ac)	1.11	0.19	0.39	5.13	3.83	4.55	18.18	4.84	2.97	2.69	5.78	2.12	28.13	10.66	4.19	4.66	3.88	2.83	3.24	
Owning & Operating Cost - Low Rates ($/ac)	0.60	0.10	0.39	6.59	6.11	6.85	9.36	3.08	2.15	1.67	4.66	0.62	16.31	7.34	2.94	4.66	3.07	3.84	3.34	
Gross Value MOG Crop ($)	6130	6130	6130	6130	6130	6130	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	
Cost of Crop Production $	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Value of Grain Loss - High Rate ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Value of Grain Loss - Low Rate ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Crop Value - High Rate of Operating Cost ($/ac)	3.63	3.63	3.43	0.09	0.09	-0.82	11.06	9.73	9.73	9.73	10.99	11.23	8.52	8.52	9.35	9.71	9.71	9.67	9.99	
Crop Value - Low Rate of Operating Cost ($/ac)	3.63	3.63	3.63	3.63	3.63	3.63	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	2.52	3.05	3.43	-1.91	-0.21	-0.82	-6.45	6.89	6.76	9.73	2.99	9.61	-8.40	1.73	7.64	6.62	8.23	8.80	8.49	
Crop Value - Operating & Ownership Cost - Low Rate ($/ac)	3.02	3.05	3.43	-2.67	-1.48	-2.32	2.47	8.64	9.67	10.86	6.65	10.91	-3.85	4.39	8.69	7.19	8.66	7.88	8.38	



1E Farm Plan 1 - System 1

Press **"CONTROL& SHIFT & U"** to transfer **Farm Plan 1 -System 1** Machinery Selection to this Summary Sheet

Option	1						2			3			FP1-SYS1 Summary Grain Only	4	FP1-SYS1 Summary MOG	FP1-SYS1 Summary Grain & MOG
Machine Name	Cutting - Gathering Equipment -						Harvesting Equipment			Grain Handling Equipment				Straw and Chaff Equipment		
Operating Parameters	1c	2b	3b	6b	6b	7c	1f	2c	4d	1c	3b	4e				
Machine Value ($)	30,000	6,000	10,000	5,000	5,000	20,000	150,000	10,000	35,000	50,000	15,000	15,000				
Portion of Investment Financed (%)	40	20	20	0	0	10	30	10	30	10	10	10				
Financing Charges - High (%)	10	10	10	10	10	10	10	10	10	10	10	10				
Financing Charges - Low (%)	5	5	5	5	5	5	6	5	5	5	5	5				
Depreciation Rate - High (%)	10	5	10	2	2	10	10	5	10	20	5	10				
Depreciation Rate - Low (%)	5	2	5	0	0	5	10	2	5	10	2	2				
Depreciation - High Rate ($/year)	1,200	120	300	0	0	200	4,500	100	1,050	2,500	100	100	10270		0	10,270
Financing Cost - Low Rate ($/year)	600	60	150	0	0	100	2,250	50	525	1,250	75	75	5138		0	5,138
Depreciation - High Rate ($/year)	3,000	300	1,000	100	100	2,000	22,500	500	3,500	10,000	750	1,500	40700		0	40,700
Depreciation - Low Rate ($/year)	1,500	120	750	0	0	1,000	15,000	200	1,750	5,000	300	300	25830		0	25,830
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2300		1,860	2300
Area of Crop Windrowed	1,070	1,070		1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070				
Area of Crop Direct Cut			1,230				1,230			1,230	1,230	1,230				
Area of Crop Stressed							1,550		1,550	1,550	1,550	1,550				
Use - Area of crop per year (ac)	1070	570	1230	1070	1070	570	2300	2300	2300	2300	2300	2300				
Operating Time - Hiser Work Rate (h)	49	26	56	71	71	26	153	268	230	115	20	20	1137		0	1137
Operating Time - Lower Work Rate (h)	71	38	123	153	153	38	230	460	383	230	24	24	1925		0	1925
Hours of Use for Season						150			306	460	40	300				
Fuel Use Rate- High (L/h)	25	0	0	0	0	25	30	0	35	30	0	25				
Fuel Use Rate - Low (L/h)	10	0	0	0	0	10	25	0	25	15	0	15				
Loss - High (% of yield)	3	3	2.5	2	2	0	5	3	0	0	0	0				
Loss - Low (% of yield)	0.5	0.5	1	0.2	0.2	0	1	1	0	0	0	0				
Work Rate Rate - Higher (ac/h)	22	22	19	15	15	22	13	8	10	20	115	115				
Work Rate - Lower (ac/h)	15	15	10	7	7	15	10	5	6	10	95	95				
Operator Labour Rate ($/h)	15	0	0	0	0	15	15	0	15	15	0	15				
Maintenance Cost Estimate - High Rate($/h)	10	0	20	2	2	3	10	10	10	15	20	10				
Maintenance Cost Estimate - Low Rate ($/h)	5	2	9	0.5	0.5	2	10	5	5	5	8	5				
Cost of fuel - High Rate ($)	727	0	0	0	0	421	3488	0	5233	2243	0	325	12436		0	12436
Cost of fuel - Low Rate ($)	484	0	0	0	0	371	3738	0	6229	2363	0	236	13279		0	13279
Cost of Labour - High Rate($)	730	0	0	0	0	369	2300	0	3450	1725	0	300	8893		0	8893
Cost of Labour - Low Rate ($)	1070	0	0	0	0	570	3450	0	5750	3450	0	363	14653		0	14653
Maintenance - High Rate ($)	730	130	1367	143	143	130	2300	2875	2300	1725	460	200	12441		0	12441
Maintenance - Low Rate ($)	357	76	615	76	76	76	2300	2300	1917	1150	121	121	9183		0	9183
Depreciation - High ($/h)	82	12	32	1	1	35	147	2	18	25	19	9				
Depreciation - Low ($/h)	21	3	9	0	0	10	38	0	5	13	5	1				
Depreciation - High ($/ac)	2.80	0.53	1.32	0.36	0.36	0.91	6.52	0.09	1.79	1.25	0.18	0.04				
Depreciation - Low ($/ac)	1.40	0.31	0.81	0.00	0.00	0.47	1.65	0.00	1.46	0.65	0.05	0.01				
Depreciation - Low ($/ac)	1.40	0.31	0.81	0.00	0.00	0.47	29	0	5	6.25	3.75	0.50				
Finance Costs - High Rate ($/h)	25	5	4	0	0	2	19	0	5	3.13	1.88	0.25				
Finance Costs - Low Rate ($/h)	6	2	1	0	0	1	1.96	0.04	0.93	0.31	0.03	0.00				
Finance Costs - High Rate ($/ac)	1.12	0.21	0.24	0.00	0.00	0.09	0.98	0.02	0.44	0.31	0.02	0.00				
Finance Costs - Low Rate ($/ac)	0.56	0.11	0.12	0.00	0.00	0.07										
Maintenance Cost - High Rate ($/ac)	0.68	0.23	1.11	0.13	0.13	0.23	1.00	1.25	1.00	0.75	0.17	0.09				
Maintenance Cost - Low Rate ($/ac)	0.33	0.13	0.50	0.07	0.07	0.13	1.00	1.00	0.83	0.50	0.08	0.05				
Labour Cost - High Rate ($/ac)	0.68	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.50	0.75	0.00	0.13				
Labour Cost - Low Rate ($/ac)	1.00	0.00	0.00	0.00	0.00	0.00	1.50	0.00	2.50	1.50	0.00	0.19				
Operating Costs - High Rate ($/h)	44.88	8.00	39.00	2.00	2.00	38.25	92.75	10.00	47.75	40.00	20.00	41.25				
Operating Costs - Low Rate ($/h)	26.50	3.00	5.00	0.50	0.50	26.75	91.25	5.00	36.25	39.75	9.00	39.75				
Operating Costs - Low Rate ($/ac)	2.34	0.35	1.11	0.13	0.13	1.85	3.52	1.25	4.75	3.48	0.17	0.38				
Operating Costs - High Rates ($/ac)	1.77	0.13	0.96	0.07	0.07	1.79	4.13	1.09	6.04	2.98	0.06	0.31				
Operating Costs - Low Rates ($/ac)																
Cleaning & Operating Costs - High Rates ($/h)	131.31	21.21	46.34	3.49	3.49	59.75	259.04	12.89	70.30	80.75	42.60	46.75				
Cleaning & Operating Cost - Low Rates ($/h)	59.04	6.74	12.37	0.69	0.69	37.75	195.25	6.04	47.63	49.25	14.39	31.69				
Cleaning & Operating Costs - High Rates ($/ac)	5.97	0.93	2.57	0.33	0.33	2.66	16.28	1.81	7.95	4.04	0.37	0.41				
Cleaning & Operating Cost - Low Rates ($/ac)	2.73	0.45	1.23	0.07	0.07	2.02	11.65	1.11	7.84	4.04	0.15	0.35				
Gross Value Grain Cross($)	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360550	360,550		27827	388,377
Cost of Crop Production $	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324,640		0	324,640
Value of Grain Loss - High Rate ($)	4736	2523	5068	3157	3157	0	18028	4736	0	0	0	0	41403		0	41403
Value of Grain Loss - Low Rate ($)	789	420	2027	316	316	0	3606	1579	0	0	0	0	9052		0	9052
Crop Value - High Rate of Operating Cost ($/ac)	27.69	69.35	23.88	30.46	30.46	61.35	4.26	12.30	10.84	13.14	16.44	15.25				
Crop Value - Low Rate of Operating Cost ($/ac)	32.52	62.26	27.56	33.27	33.27	63.60	14.85	14.85	15.61	15.61	15.61	15.61				
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	23.17	67.01	22.59	30.39	30.39	60.35	-7.48	12.64	6.69	11.65	16.34	16.21				
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	28.00	61.61	26.32	33.19	33.19	62.46	2.62	15.00	7.68	11.65	15.45	15.59				



1F Farm Plan 1 - System 2

Press "CONTROL & SHIFT & V" to transfer **Farm Plan 1 - System 2** Machinery Selections to this Summary Sheet

Option	1						2			3			FP1 SYS 2 Summary	4				FP1 SYS 2 Summary MOC Only	FP1 SYS 2 Summary Costs & MOC
Machine Name																			
Selection	1a	2b	3c	4d	5e	7a	1a	2b	4d	1a	2b	4e	Daily Cost	1a	2b	3c	4d		
Machine Value ($)	30,000	6,000	15,000	5,000	5,000	20,000	150,000	10,000	35,000	50,000	15,000	15,000		30,00	10,000	15,000	40,000		
Portion of Investment Financed (%)	40	20	20	0	0	10	30	10	30	10	10	10		0	0	20	30		
Financing Charges - High (%)	10	10	10	10	10	10	10	10	10	10	10	10		10	0	10	10		
Financing Charges - Low (%)	5	5	5	5	5	5	5	5	5	5	5	5		5	0	5	5		
Depreciation Rate - High (%)	10	5	10	2	2	10	15	5	10	20	5	10		0	0	10	15		
Depreciation Rate - Low (%)	5	2	5	0	0	5	10	2	5	10	2	2		0	0	5	10		
Depreciation Rate - Low (%)	5	2	5	0	0	5	10	2	5	10	2	2		0	0	5	5



Farm Plan 2

Press "CONTROL& SHIFT & S" to reset Farm Plan 2 to the original data

	CROPS																		TOTALS			
	Barley 1		Barley 2		Canola		Pulse 1		Pulse 2		Wheat 1		Wheat 2		Other 1		Other 2		Other 3		Windrow	Direct Cut	Stripper	Total
	320	160		160	480			300		140	300	150		320										
		65		50		30		50		30		40		60										
Gross Bushels	20800	10400	0	12000	13920	0	0	15000	0	4200	12000	6000	0	19200	0	0	0	0	0	0	46320	37000	35400	118720
		2.5		2.5		6.87		4.38		7.5		6.38		3.75										
	420	400		480	730			300		200	480	400		400										
Total Chaff (tonnes)		96.2		32.7		153.4		40.9		12.7		92.7		56.2		0.0		0.0		0.0				489
		0.005		0.005				0.01	$	0.01		0.005		0.005										
	0.9	0.7		1.17	0.34			1		0.5	0.75	0.75		1										
Total Straw (tonnes)		400		187.2		153		300		70		337.5		320		0		0		0				1766
		10		10				20		20		10		10										
Gross Value Grain ($) by method	52000	26000	0	30000	62748	0	0	60750	0	31500	52980	26390	0	73000	0	0	0	0	0	0	197248	240490	208440	486178
Total Gross Grain Value ($)	$	78,000.00	$	52,000.00	$	62,748.00	$	66,750.00	$	31,500.00	$	79,848.00	$	73,000.00	$	-	$	-	$	-				$ 486,786.00
Gross Grain Value ($/ac)	$	162.50	$	200.00	$	209.16	$	218.00	$	225.00	$	175.20	$	225.00	#DIV/0!		#DIV/0!		#DIV/0!					
Gross Value of Chaff ($) - area (ac)	$ 1,080.00	480	$ 360.00	160	$ -		$ 900.00	300	$ 280.00	140	$ 1,020.00	450	$ 640.00	320	$ -		$ -				Chaff acres =	1850		$ 6,130.00
Gross Value of Straw ($)- area (ac)	$ 4,000.00	480	$ 1,872.00	160	$ -		$ 6,000.00	300	$ 1,400.00	140	$ 3,375.00	450	$ 3,200.00	320	$ -		$ -				Straw acres =	1850		$ 21,697.00
Gross Value Chaff - Straw ($/ac)	$ 2.25	$ 8.33	$ 2.25	$ 11.70	$ -	$ -	$ 3.00	$ 20.00	$ 2.00	$ 10.00	$ 2.27	$ 7.50	$ 2.00	$ 10.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				
		10		10		25		40		40		15		15										22.143
		30		30		60		18		18		60		60										44.29
		27.5		27.5		35		30		30		30		30										30.00
		3		3		4		3		3		4		4										3.43
		20		20		20		20		20		20		20										20.00
		8		8		15		15		15		10		10										11.57
		7		7		7		7		7		7		7										7.00
Preharvest Grain Value ($)	$	17,760.00	$	11,840.00	$	18,845.00	$	20,700.00	$	13,500.00	$	13,140.00	$	26,280.00	$	-	$	-	$	-				$ 121,965
Preharvest Grain Value ($/ac)	$	37.00	$	74.00	$	48.19	$	69.00	$	96.43	$	29.20	$	79.64	#DIV/0!		#DIV/0!		#DIV/0!					68.7
Preharvest Grain Value ($ of Crop)	$	25.5	$	25.4	$	30.9	$	49.3	$	25.1	$	16.5	$	54.0	#DIV/0!		#DIV/0!		#DIV/0!					25.1
Preharvest Grain & Straw Value ($)	$	21,760.00	$	13,792.00	$	16,845.00	$	32,700.00	$	14,700.00	$	16,515.00	$	26,480.00	$	-	$	-	$	-				$ 145,992.00

Harvest Equipment	
Cost of Fuel - Diesel ($/L)	0.65
Cost of Fuel - Gas ($/L)	0.68
Labour Rate ($/h)	18

Guidelines for calculating MOG (straw & chaff)

Typical Straw/Chaff ratios for

	short straw	average straw	tall straw
wheat	low = 0.6 - 0.9	avg = 0.8 - 1.0	high = 1.0 -1.3
barley	low = 0.5 - 0.65	avg = 0.65 - 0.75	high = 0.75 - 1.2
canola	low = 1.0 -1.5	avg = 2.0 -2.5	high = 2.5 - 3
flax		avg = 2.0 - 2.5	

Typical Chaff MOG ratios for

wheat	Conventional = 2 - 4	Rotary = 25 - 55
barley	Conventional = 15 - 3	Rotary = 2 - 45
canola	Conventional = 15 - 30	Rotary = 25 - 65
flax	Conventional = 10 - 20	Rotary = 2 - 3

Example Wheat with yield of 50bu/ac X 60 lb/bu = 3000 lb/ac of grain for MOG/G of 1 then that means there a 3000lb/ac of MOG (chaff and straw) of which 30% is chaff so their would be 900 lb of chaff and 2100 lb of straw

2A - Cutting and Gathering

SYSTEM 1
SYSTEM 2

Ownership Costs																				
Total Cost of Ownership - High Rate ($/year)	20,700	19,000	4,200	1,500	1,500	420	150	5,250	1,800	100	10,500	10,500	2,600	7,500	4,500	2,250	100	21,250	3,900	2,200
Total Cost of Ownership - Low Rate ($/year)	14,850	9,250	2,100	750	750	100	50	2,625	900	0	5,400	5,250	750	3,750	2,250	1,125	0	6,375	2,340	1,100
Operating Parameters																				
Variable Input Operating Costs																				
Operating Cost																				
Total ($) - High Rate	2,088	2,088	2,184	1,613	134	130	126	1,347	1,347	1,347	1,538	432	315	1,732	1,732	140	140	595	979	959
Total ($) - Low Rate	1,840	1,840	1,840	950	76	76	76	615	615	615	1,025	310	310	775	775	70	70	1,611	1,611	1,611
Calculated Cost Rates																				
Owning & Operating - High Rates ($/hour)	21,888	12,188	6,384	2,513	1,634	550	280	6,647	3,147	1,447	20,438	10,933	3,615	9,207	6,222	2,343	243	3,662	1,567	1,509
Owning & Operating - Low Rates ($/hour)	16,740	9,169	3,990	1,700	826	256	106	3,240	1,515	615	10,475	6,763	1,263	4,525	3,025	1,201	76	2,239	1,492	1,405
Crop Value																				
Crop Value - Production and High Loss ($)	125,226	125,226	125,226	125,376	122,992	122,992	122,992	119,808	119,808	119,808	121,875	121,875	121,875	117,375	117,375	122,100	122,100	126,145	126,145	126,145
Crop Value - Production and Low Loss ($)	125,158	125,158	125,158	125,684	125,619	125,619	125,619	121,810	122,610	123,610	124,878	124,878	124,878	117,375	117,375	125,756	125,756	126,143	126,145	126,145
Crop Value - High Rate of Operating Costs ($)	118,040	118,040	118,040	122,367	122,862	122,862	122,862	118,441	118,441	118,441	119,538	120,153	120,466	115,653	115,653	122,056	122,056	125,266	125,266	125,266
Crop Value - Low Rate of Operating Costs ($)	123,268	123,268	123,268	124,734	125,543	125,543	125,543	122,995	122,995	122,995	123,653	124,365	124,365	116,606	116,606	125,674	125,674	125,129	125,129	125,129
Crop Value - Op. & Own Cost - High Rates ($)	86,340	100,040	112,840	120,867	121,362	122,442	122,712	113,191	118,341	118,341	100,538	118,153	117,460	106,153	111,153	119,806	121,956	122,453	124,558	124,650
Crop Value - Op. & Own Cost - Low Rates ($)	105,618	117,918	121,168	123,984	124,793	125,363	125,453	120,376	122,945	122,995	114,403	118,115	123,615	112,650	114,356	124,543	125,674	123,817	124,654	124,711

2A - Cutting and Gathering

Enter number (1,2,3 etc.) for # of machines selected for each system in box above machine column (1a, 2b etc.)																						
SYSTEM 1			1			1			1								2					1
SYSTEM 2			1			1			1								2					1
	1a	1b	1c	1d	2a	2b	2c	3a	3b	3c	4a	4b	4c	5a	5b	6a	6b	7a	7b	7c		
Option	1				2			3			4			5		6		7				
Machine Name	Windrower - SP - 30				Windrower PT - 30			Direct Cut - Auger -30			Direct Cut Draper - 30			Stripper - 28		Pickup		Tractor (100) for PT				
Selection	1a	1b	1c	1d	2a	2b	2c	3a	3b	3c	4a	4b	4c	5a	5b	6a	6b	7a	7b	7c		
Machine Value ($)	110,000	50,000	30,000	15000	10,000	6,000	3,000	35,000	15,000	5000	70,000	50,000	25,000	50,000	30,000	15,000	5,000	85,000	40,000	20,000		
Portion of Investment Financed (%)	70	50	40	0	50	25	0	50	20	0	70	50	20	50	50	50	0	50	25	10		
Financing Charges - High (%)	10	10	10	10	10	10	0	10	10	0	10	10	10	10	10	10	10	10	10	10		
Financing Charges - Low (%)	5	5	5	5	5	5	0	5	5	0	5	5	5	5	5	5	5	5	5	5		
Depreciation Rate - High (%)	20	15	10	10	10	5	5	10	10	2	20	13	10	10	10	10	2	30	10	10		
Depreciation Rate - Low (%)	10	10	5	5	5	2	2	5	5	0	10	10	2	5	5	5	0	5	5	5		
Financing Cost - High Rate ($/year)	7,700	2,500	1,200	0	500	120	0	1,750	300	0	4,900	2,500	500	2,500	1,500	750	0	4,388	1,000	200		
Financing Cost - Low Rate ($/year)	3,850	1,250	600	0	250	60	0	875	150	0	2,450	1,250	250	1,250	750	375	0	2,125	500	100		
Depreciation - High Rate ($/year)	22,000	7,500	3,000	1,500	1,000	300	150	3,500	1,500	100	14,000	7,500	2,500	5,000	3,000	1,500	100	17,000	4,000	2,000		
Depreciation - Low Rate ($/year)	11,000	5,000	1,500	750	500	120	60	1,750	750	0	7,000	5,000	500	2,500	1,500	750	0	4,250	2,000	1,000		
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300		
Area of Crop Windrowed	1,070	1,070	1,070	1,070	1,070	1,070	1,070									1,070	1,070	1,070	1,070	1,070		
Area of Crop Direct Cut								1,230	1,230	1,230	1,230	1,230	1,230									
Area of Crop Stripped														1,550	1,550							
Use - Area of crop per year (ac)	1070	1070	1070	560	670	670	570	1230	1230	1230	1230	1230	1230	1550	1550	1070	1070	570	570	570		
Operating Time - Hour Work Rate (h)	49	49	49	23	38	38	25	68	68	68	62	62	62	57	57	71	71	28	28	28		
Operating Time - Lower Work Rate (h)	71	71	71	33	38	38	38	123	123	123	103	103	103	78	78	153	153	38	38	38		
Hours of Use for Year																		200	200	100		
Fuel Use Rate- High (L/h)	33	33	33	33	0	0	0	0	0	0	0	0	0	0	0	0	0	38	38	38		
Fuel Use Rate - Low (L/h)	19	19	19	19	0	0	0	0	0	0	0	0	0			0	0	15	15	15		
Loss - High (% of yield)	3	3	3	3	3	3	3	2.5	2.5	2.5	2	2	2	5	5	2	2	0	0	0		
Loss - Low (% of yield)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	0.5	0.5	0.5	3	3	0.2	0.2	0	0	0		
Work Rate Rate - Higher (ac/h)	22	22	22	22	22	22	22	18	18	18	20	20	20	27	27	14	14	22	22	22		
Work Rate - Lower (ac/h)	15	15	15	15	15	15	15	10	10	10	12	12	12	20	20	7	7	15	15	15		
Operator Labour Rate ($/h)	15	15	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	15		
Maintenance Cost Estimate - High Rate($/h)	15	15	15	10	5	5	5	20	20	20	25	15	10	30	30	2	2	5	5	5		
Maintenance Cost Estimate - Low Rate ($/h)	5	5	5	5	2	2	2	5	5	5	10	5	5	10	10	0.5	0.5	2	2	2		
Cost of fuel - High Rate ($)	727	727	727	444	0	0	0	0	0	0	0	0	0	0	0	0	0	421	421	421		
Cost of fuel - Low Rate ($)	484	484	484	283	0	0	0	0	0	0	0	0	0	0	0	0	0	371	371	371		
Cost of Labour - High Rate($)	730	730	730	341	0	0	0	0	0	0	0	0	0	0	0	0	0	386	386	386		
Cost of Labour - Low Rate ($)	1070	1070	1070	500	0	0	0	0	0	0	0	0	0	0	0	0	0	570	570	570		
Maintenance - High Rate ($)	730	730	730	227	130	130	130	1387	1387	1387	1538	923	615	1722	1722	143	143	130	130	130		
Maintenance - Low Rate ($)	357	357	357	167	76	76	76	615	615	615	1025	513	513	775	775	76	76	76	76	76		
Depreciation - High ($/h)	452	154	62	66	39	12	6	51	22	1	226	122	41	87	52	21	1	86	20	20		
Depreciation - Low ($/h)	184	70	21	23	13	3	2	14	6	0	69	49	5	22	10	5	0	21	10	10		
Depreciation - High ($/ac)	20.56	7.01	2.80	3.00	1.75	0.53	0.26	2.85	1.22	0.08	11.30	6.10	2.03	3.23	1.94	1.40	0.09	3.86	0.91	0.91		
Depreciation - Low ($/ac)	8.38	3.19	0.95	1.05	0.58	0.13	0.11	1.12	0.51	0.00	5.65	4.07	0.41	1.51	0.67	0.70	0.00	1.42	0.67	0.67		
Depreciation - Low ($/ac)	10.39	4.67	1.40	1.59	0.89	0.21	0.11	1.42	0.61	0.00	8.0	4.1	0.8	4.4	2.8	1.1	0	2.1	0.9	0.2		
Finance Costs - High Rate ($/h)	189	91	25	6	19	5	0	26	4	0	24	12	2	16	10	2	0	11	3	1		
Finance Costs - Low Rate ($/h)	84	19	8	0	7	2	0	7	1	0	24	12	2	16	10	2	0	11	3	1		
Finance Costs - High Rate ($/ac)	7.20	2.34	1.12	0.00	0.88	0.21	0.00	1.42	0.24	0.00	3.58	2.03	0.41	1.91	0.97	0.79	0.00	0.97	0.33	0.09		
Finance Costs - Low Rate ($/ac)	3.60	1.17	0.55	0.00	0.44	0.11	0.00	0.71	0.12	0.00	1.99	1.02	0.20	0.81	0.48	0.35	0.00	0.71	0.17	0.07		
Maintenance Cost - High Rate ($/ac)	0.68	0.68	0.68	0.45	0.23	0.23	0.23	1.11	1.11	1.11	1.25	0.75	0.50	1.11	1.11	0.13	0.13	0.23	0.23	0.23		
Maintenance Cost - Low Rate ($/ac)	0.33	0.33	0.33	0.33	0.13	0.13	0.13	0.50	0.50	0.50	0.83	0.42	0.42	0.50	0.50	0.07	0.07	0.13	0.13	0.13		
Labour Cost - High Rate ($/ac)	0.68	0.68	0.68	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Labour Cost - Low Rate ($/ac)	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00		
Operating Costs - High Rate ($/h)	44.85	44.85	44.85	44.85	5.00	5.00	5.00	20.00	20.00	20.00	25.00	15.00	10.00	20.00	20.00	2.00	2.00	35.35	35.35	35.35		
Operating Costs - Low Rate ($/h)	29.90	29.90	29.90	29.90	2.00	2.00	2.00	5.00	5.00	5.00	10.00	5.00	5.00	10.00	10.00	0.50	0.50	29.75	29.75	29.75		
Operating Costs - High Rates ($/ac)	2.04	2.04	2.04	2.03	0.23	0.23	0.23	1.11	1.11	1.11	1.25	0.75	0.50	1.11	1.11	0.13	0.13	1.65	1.65	1.65		
Operating Costs - Low Rates ($/ac)	1.77	1.77	1.77	1.90	0.13	0.13	0.13	0.50	0.50	0.50	0.83	0.42	0.42	0.50	0.50	0.07	0.07	1.76	1.76	1.76		
Owning & Operating Costs - High Rates ($/h)	666.69	269.69	131.31	119.95	62.89	21.21	10.79	96.63	46.34	21.46	332.32	177.60	69.76	169.65	108.39	33.54	3.40	142.50	61.25	59.25		
Owning & Operating Costs - Low Rates ($/h)	234.69	114.12	65.84	51.69	21.74	6.74	3.55	28.34	12.32	6.00	105.20	66.68	12.32	59.39	39.63	7.66	0.05	58.63	39.25	37.75		
Owning & Operating Cost - High Rates ($/ac)	29.60	11.39	5.97	5.03	2.86	0.96	0.49	5.38	2.57	1.19	16.62	8.88	2.84	5.65	4.61	2.24	0.23	6.40	2.70	2.65		
Owning & Operating Cost - Low Rates ($/ac)	15.66	7.61	3.73	3.40	1.45	0.45	0.24	2.63	1.23	0.60	8.52	5.80	1.03	2.92	1.95	1.12	0.07	3.81	2.62	2.52		
Gross Value Grain Crop ($)	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785		
Cost of Crop Production $	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640		
Value of Grain Loss (Method) - High Rate ($)	5919	5919	5919	2766	3153	3153	3153	6337	6337	6337	5070	5070	5070	14517	14517	3946	3946	0	0	0		
Value of Grain Loss (Method) - Low Rate ($)	957	957	957	461	526	526	526	2535	2535	2535	1267	1257	1267	5770	5770.2	395	395	0	0	0		
Crop Value - High Rate of Operating Cost ($/ac)	110.32	110.32	110.32	264.73	215.56	215.56	215.56	96.29	96.29	96.29	97.19	97.69	97.94	74.61	74.61	114.97	114.97	219.66	219.66	219.66		
Crop Value - Low Rate of Operating Cost ($/ac)	116.97	116.97	116.97	251.37	220.39	220.39	220.39	100.50	100.50	100.50	101.53	101.53	101.53	79.73	79.73	117.52	117.52	221.31	221.31	221.31		
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	52.59	109.97	109.39	241.73	212.82	214.81	215.38	92.85	94.83	96.21	81.62	89.56	95.50	69.76	71.71	111.97	113.85	214.53	218.52	218.66		
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	101.33	109.38	113.24	247.97	218.94	218.94	220.18	97.85	99.26	100.98	85.01	98.03	100.80	72.81	73.77	116.40	117.45	217.40	218.69	218.79		

2B Harvesting

SYSTEM 1
SYSTEM 2

Ownership Costs																			
Total Cost of ownership - High Rate ($/year)	112,000	94,500	78,000	62,500	38,000	27,000	12,500	5,500	4,500	1,400	500	15,000	5,000	40,500	23,000	12,350	4,550	3,600	
Total Cost of ownership Low Rate ($/year)	76,000	54,750	54,000	43,750	24,000	17,250	5,000	2,750	2,250	600	250	7,500	3,000	20,250	7,500	7,000	4,275	450	
Operating Parameters																			
Variable input Operating Costs																			
Fuel Price ($/L)																			
Operating Cost																			
Total ($) - High Rate	7,657	7,657	6,717	8,210	7,794	3,460	3,460	11,585	1,417	2,048	2,913	14,863	4,400	15,000	12,750	10,500	10,500	10,500	
Total ($) - Low Rate	6,567	6,567	5,560	10,110	9,460	5,460	10,925	14,347	1,436	1,917	2,390	1,917	1,917	14,860	10,130	10,130	10,640	10,640	
Calculated Cost Rates																			
Fuel Cost - High Rate $/Ha	22.50	22.50	20.25	29.25	26.00	15.75	13.50	10.00	3.50	3.50	3.50	3.50	3.50	180.00	90.00	45.00	22.50	11.25	
Fuel Cost - Low Rate $/Ha	28.50	28.50	22.75	22.75	19.50	18.20	13.00	10.00	3.50	3.50	3.50	3.50	3.50	180.00	90.00	45.00	22.50	11.25	
Fuel Cost - High Rate $/Ha	2.50	2.50	2.25	2.45	2.60	2.63	2.70	2.86	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	
Fuel Cost - Low Rate $/Ha	3.17	3.17	2.53	1.90	1.95	3.03	2.60	2.86	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	
Owning & Operating - High Rates ($/hour)	119,657	101,357	84,717	70,710	45,794	30,588	21,460	16,085	6,417	3,700	3,413	19,500	10,000	37,231	29,960	22,945	15,310	12,965	
Owning & Operating - Low Rates ($/hour)	84,567	73,317	62,560	52,860	33,460	26,730	15,925	17,317	3,936	2,517	2,550	3,417	4,917	34,960	22,353	27,192	15,256	13,410	
Crop Value																			
Crop Value - Production and High Loss ($)	103,606	103,606	103,606	103,606	103,606	103,606	93,003	103,606	129,226	129,226	129,226	112,621	112,621	126,145	126,145	126,145	126,145	126,145	
Crop Value - Production and Low Loss ($)	121,637	121,637	121,637	121,637	121,637	121,637	92,227	121,637	124,172	124,172	124,172	121,637	121,637	126,145	126,145	126,145	126,145	126,145	
Crop Value - High Rate of Operating Costs ($)	96,549	96,549	96,549	95,396	95,611	95,517	94,165	92,221	118,509	117,326	117,251	118,720	118,720	111,463	112,417	111,563	112,245	113,405	
Crop Value - Low Rate of Operating Cost ($)	113,039	113,039	113,549	111,327	112,150	112,150	110,712	107,070	122,734	122,255	121,872	118,720	118,720	111,463	112,417	111,563	112,245	113,405	
Crop Value - Op. & Own Cost - High Rates ($)	-13,451	2,049	18,889	32,896	57,811	68,517	82,118	86,721	113,809	119,526	116,751	93,221	102,621	88,914	96,245	103,801	109,330	113,840	
Crop Value - Op. & Own Cost - Low Rates ($)	37,050	48,320	59,549	67,277	88,150	94,360	104,712	104,320	120,464	121,653	121,622	112,220	116,720	92,074	103,792	96,642	107,669	112,632	

2B Harvesting

Enter number (1,2,3 etc) for # of machines selected for each system in box above machine column (1a,2b etc)

SYSTEM 1						1					1							1	
SYSTEM 2						1					1							1	
	1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	3a	3b	4a	4b	4c	4d	4e	
Option	1								2			3		4					
Machine Name	Combine - SP								Combine - PT			Combine - Slickbowl		Tractor					
Selection	1a	1b	1c	1d	1e	1f	1g	1h	2a	2b	2c	3a	3b	4a	4b	4c	4d	4e	
Machine Value ($)	400,000	350,000	300,000	250,000	200,000	150,000	100,000	50,000	30,000	20,000	10,000	100,000	50,000	150,000	100,000	65,000	35,000	15,000	
Portion of Investment Financed (%)	80	70	60	50	40	30	20	10	50	30	10	50	20	70	50	40	30	20	
Financing Charges - High (%)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
Financing Charges - Low (%)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Depreciation Rate - High (%)	20	20	20	20	15	15	10	10	10	5	5	10	10	20	20	15	10	10	
Depreciation Rate - Low (%)	15	15	15	15	10	10	5	5	5	2	2	5	5	10	5	10	5	2	
Financing Cost - High Rate ($/year)	32,000	24,500	18,000	12,500	8,000	4,500	2,000	500	1,500	400	100	5,000	1,000	10,500	5,000	2,600	1,050	300	
Financing Cost - Low Rate ($/year)	16,000	12,250	9,000	6,250	4,000	2,250	1,000	250	750	200	50	2,500	500	5,250	2,500	1,300	525	150	
Depreciation - High Rate ($/year)	80,000	70,000	60,000	50,000	30,000	22,500	10,000	5,000	3,000	1,000	500	10,000	5,000	30,000	20,000	9,750	3,500	1,500	
Depreciation - Low Rate ($/year)	60,000	52,500	45,000	37,500	20,000	15,000	5,000	2,500	1,500	400	200	5,000	2,500	15,000	5,000	6,500	1,750	300	
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	
Area of Crop Windrowed	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	
Area of Crop Direct Cut	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230				1,230	1,230					1,230	
Area of Crop Stripped	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550						1,550	1,550	1,550	1,550	1,550	
Use - Area of crop per year (ac)	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	
Operating Time - Higher Work Rate (h)	105	105	105	128	128	153	192	230	192	230	288	230	230	192	192	230	230	230	
Operating Time - Lower Work Rate (h)	153	153	153	192	192	230	288	383	288	383	460	383	383	288	288	383	383	383	
Hours of Use for Year														300	250	250	200	200	
Fuel Use Rate- High (L/h)	50	50	45	45	40	35	30	30	0	0	0	0	0	45	40	35	25	30	
Fuel Use Rate - Low (L/h)	40	40	35	35	30	25	20	20	0	0	0	0	0	40	35	30	25	20	
Loss - High (% of yield)	5	5	5	5	5	5	5	5	3	3	3	3	3	0	0	0	0	0	
Loss - Low (% of yield)	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	
Work Rate Rate - Higher (ac/h)	22	22	22	18	18	15	12	10	12	10	8	10	10	12	12	10	10	10	
Work Rate - Lower (ac/h)	15	15	15	12	12	10	8	6	8	6	5	6	6	8	8	6	6	6	
Operator Labour Rate ($/h)	15	15	15	15	15	15	15	15	0	0	0	0	0	15	15	15	15	15	
Maintenance Cost Estimate - High Rate($/h)	20	20	20	20	20	15	15	15	10	10	10	20	20	15	15	10	10	10	
Maintenance Cost Estimate - Low Rate ($/h)	15	15	15	15	15	10	10	10	5	5	5	5	5	10	10	5	5	5	
Cost of fuel - High Rate ($)	3398	3398	3056	3736	3322	3486	3736	4465	0	0	0	0	0	9906	4963	5233	5233	4465	
Cost of fuel - Low Rate ($)	3967	3967	3485	4360	3736	3736	3736	4963	0	0	0	0	0	7475	6541	7475	6229	4963	
Cost of Labour - High Rate($)	1568	1568	1568	1917	1917	2300	2875	3450	0	0	0	0	0	2875	2875	2450	3450	3450	
Cost of Labour - Low Rate ($)	2300	2300	2300	2875	2875	3450	4313	5750	0	0	0	0	0	4313	4313	5750	5750	5750	
Maintenance - High Rate ($)	2091	2091	2091	2596	2596	2300	2875	3450	1917	2300	2875	4600	4600	2875	2875	2300	2300	2300	
Maintenance - Low Rate ($)	2300	2300	2300	2875	2875	2300	2875	3833	1438	1917	2300	1917	1917	2875	2875	1917	1917	1917	
Depreciation - High ($/h)	765	670	574	391	235	147	52	22	16	4	2	43	22	100	80	39	18	8	
Depreciation - Low ($/h)	391	342	293	196	104	65	17	7	5	1	0	13	7	50	20	26	9	2	
Depreciation - High ($/ac)	34.78	30.43	26.09	21.74	13.04	9.78	4.35	2.17	1.30	0.43	0.22	4.35	2.17	8.33	6.67	3.90	1.75	0.75	
Depreciation - Low ($/ac)	26.09	22.83	19.57	16.30	8.70	6.52	2.17	1.09	0.65	0.17	0.09	2.17	1.09	6.25	2.50	4.33	1.46	0.25	
Finance Costs - High Rate ($/h)	306	234	172	96	63	29	10	2	8	2	0	22	4	35	20	10	5	2	
Finance Costs - Low Rate ($/h)	104	80	59	33	21	10	3	1	3	1	0	7	1	18	10	5	3	1	
Finance Costs - High Rate ($/ac)	13.91	10.65	7.83	5.43	3.48	1.96	0.87	0.22	0.65	0.17	0.04	2.17	0.43	2.92	1.67	1.04	0.53	0.15	
Finance Costs - Low Rate ($/ac)	6.96	5.33	3.91	2.72	1.74	0.96	0.43	0.11	0.33	0.09	0.02	1.09	0.22	2.19	1.25	0.67	0.44	0.13	
Maintenance Cost - High Rate ($/ac)	0.91	0.91	0.91	1.11	1.11	1.00	1.25	1.50	0.83	1.00	1.25	2.00	2.00	1.25	1.25	1.00	1.00	1.00	
Maintenance Cost - Low Rate ($/ac)	1.00	1.00	1.00	1.25	1.25	1.00	1.25	1.67	0.63	0.83	1.00	0.83	0.83	1.25	1.25	0.83	0.83	0.83	
Labour Cost - High Rate ($/ac)	0.68	0.68	0.68	0.83	0.83	1.00	1.25	1.50	0.00	0.00	0.00	0.00	0.00	1.25	1.25	1.50	1.50	1.50	
Labour Cost - Low Rate ($/ac)	1.00	1.00	1.00	1.25	1.25	1.50	1.88	2.50	0.00	0.00	0.00	0.00	0.00	1.88	1.88	2.50	2.50	2.50	
Operating Costs - High Rate ($/h)	67.89	67.89	64.35	64.35	61.69	52.75	49.80	49.80	10.00	10.00	10.00	20.00	20.00	59.35	55.00	47.75	47.75	44.80	
Operating Costs - Low Rate ($/h)	55.00	55.00	52.75	52.75	49.80	41.25	38.00	38.00	5.00	5.00	5.00	5.00	5.00	51.00	47.75	35.50	38.25	33.00	
Operating Costs - High Rates ($/ac)	3.07	3.07	2.92	3.57	3.39	3.52	4.13	4.96	0.83	1.00	1.25	2.00	2.00	4.84	4.67	4.78	4.78	4.48	
Operating Costs - Low Rates ($/ac)	3.73	3.73	3.52	4.40	4.13	4.13	4.75	6.33	0.63	0.83	1.00	0.83	0.83	6.38	5.97	6.58	6.04	5.50	
Owning & Operating Costs - High Rates ($/h)	1138.80	971.44	810.34	503.38	359.39	229.84	112.11	73.41	33.48	16.09	12.09	85.22	46.09	194.25	156.00	97.15	70.50	53.50	
Owning & Operating Cost - Low Rates ($/h)	551.85	478.28	404.92	281.01	174.72	116.25	59.67	46.17	12.83	6.57	5.84	24.57	12.83	118.50	77.75	70.70	47.63	35.25	
Owning & Operating Costs - High Rates ($/ac)	51.76	44.16	36.83	30.74	18.91	15.28	9.34	7.34	2.79	1.61	1.51	8.52	4.61	16.19	13.00	9.72	7.05	5.35	
Owning & Operating Cost - Low Rates ($/ac)	30.78	31.89	26.99	23.42	14.56	11.63	7.35	7.53	1.80	1.09	1.11	4.09	2.14	14.81	9.72	11.78	7.94	5.88	
Gross Value Grain Crop ($)	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	
Cost of Crop Production $	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	
Value of Grain Lose (Method) - High Rate ($)	22539	22539	22539	22539	22539	22539	22539	22539	5919	5919	5919	13524	13524	0	0	0	0	0	
Value of Grain Lose (Method) - Low Rate ($)	4508	4508	4508	4508	4508	4508	4508	4508	1973	1973	1973	4508	4508	0	0	0	0	0	
Crop Value - High Rate of Operating Cost ($/ac)	41.95	41.95	42.13	41.45	41.95	41.53	40.92	40.10	51.44	51.27	51.02	46.97	46.97	49.91	50.16	50.57	50.07	50.40	
Crop Value - Low Rate of Operating Cost ($/ac)	52.89	52.89	52.89	52.09	52.89	52.59	52.06	52.89	53.99	53.99	53.99	52.89	52.89	54.85	54.85	54.85	54.85	54.85	
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	-9.72	0.89	8.21	14.39	28.14	39.79	38.79	37.70	49.48	50.66	50.76	40.44	44.36	30.66	41.85	45.13	47.85	49.50	
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	18.11	21.00	25.89	28.47	39.33	41.28	45.53	45.36	52.38	52.89	52.88	48.79	50.75	40.03	45.13	43.06	46.91	48.97	

2C - Grain Handling

SYSTEM 1
SYSTEM 2

Ownership Costs																		
Total Cost of ownership - High Rate ($/year)	40,700	27,750	12,500	7,500	2,400	1,100	24,500	8,800	6,050	900	100	92,500	37,500	18,750	7,500	1,650	52,500	25,000
Total Cost of ownership Low Rate ($/year)	25,650	17,625	6,250	3,750	1,200	550	15,750	4,400	4,025	375	0	33,750	18,750	9,375	3,500	375	33,750	12,500
Operating Parameters																		
Variable Input Operating Costs																		
Fuel Price ($/L)	0.65	0.65	0.65	0.65	0.65	0	0	0	0	0	0	0.65	0.65	0.65	0.65	0.65	0	0
Operating Cost																		
Total ($) - High Rate	9,266	6,266	5,693	5,523	5,329	4,792	575	787	261	400	1,533	5,266	5,266	5,357	7,002	825	4,666	3,150
Total ($) - Low Rate	7,993	7,993	6,843	6,843	6,553	5,750	207	656	65	121	575	3,827	3,827	5,740	6,843	720	2,300	2,875
Calculated Cost Rates																		
Fuel Cost - High Rate ($/h)	19.50	19.50	19.50	19.50	19.50	0.00	0.00	0.00	0.00	0.00	0.00	19.50	19.50	19.50	19.50	19.50	0.00	0.00
Fuel Cost - Low Rate ($/h)	9.75	9.75	9.75	9.75	9.75	0.00	0.00	0.00	0.00	0.00	0.00	3.00	13.00	13.00	4.75	3.75	0.00	0.00
Fuel Cost - High Rate ($/ac)	0.65	0.65	0.65	0.65	0.65	0.00	0.00	0.00	0.00	0.00	0.00	2.65	2.65	2.65	2.65	0.65	0.00	0.00
Fuel Cost - Low Rate ($/ac)	0.98	0.98	0.98	0.98	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.87	3.87	7.80	0.98	0.73	0.00	0.00
Operating Costs - High Rate ($/h)	54.50	54.50	93.50	44.50	44.50	25.00	5.00	7.00	25.00	25.00	25.00	54.50	54.50	54.50	40.00	25.00	25.00	25.00
Operating Costs - Low Rate ($/h)	34.75	34.75	29.75	29.75	29.75	20.00	3.00	3.00	5.00	5.00	5.00	29.00	29.00	29.00	29.75	29.75	20.00	20.00
Operating Costs - High Rate ($/ac)	2.73	2.73	2.40	2.97	3.71	2.08	0.50	0.70	2.08	2.08	2.08	2.73	2.73	2.73	2.86	2.08	2.08	2.08
Operating Costs - Low Rate ($/ac)	2.48	2.48	2.06	2.48	3.04	1.74	0.43	0.61	1.74	1.74	1.74	2.48	2.48	2.48	2.48	2.48	1.74	1.74
Owning & Operating - High Rates ($/harv)	10,948	9,459	9,286	9,658	9,670	5,319	14,663	7,513	662	850	1,572	41,726	20,642	17,960	10,669	935	57,166	30,750
Owning & Operating - Low Rates ($/harv)	13,938	12,046	10,436	8,999	9,416	6,143	12,382	5,520	550	548	575	23,077	15,410	15,928	9,526	751	36,050	15,375
Owning & Operating Costs - High Rates ($/h)	99.20	87.25	93.75	83.05	90.54	47.71	121.50	43.00	50.50	50.50	50.50	99.20	99.20	99.20	80.25	47.50	82.14	50.50
Owning & Operating Cost - Low Rates ($/h)	60.60	52.08	45.30	39.13	39.75	27.56	30.75	24.00	9.98	9.98	9.98	59.54	59.54	59.54	39.13	29.75	50.00	30.00
Owning & Operating Costs - High Rates ($/ac)	4.76	4.11	4.04	4.22	4.23	2.51	5.46	3.47	3.46	3.46	3.46	18.14	9.46	7.80	4.64	3.47	11.43	6.94
Owning & Operating Cost - Low Rates ($/ac)	6.00	5.24	4.54	3.91	4.24	2.67	5.56	2.48	3.46	3.46	3.46	10.03	6.70	6.92	4.14	3.23	10.00	4.17
Crop Value																		
Crop Value - Production and High Loss($)	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145
Crop Value - Production and Low Loss($)	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145	126,145
Crop Value - High Rate of Operating Costs ($)	119,878	119,878	120,453	119,322	117,616	121,353	125,570	123,378	125,864	125,745	124,612	119,878	119,878	117,788	119,053	125,320	121,545	120,395
Crop Value - Low Rate of Operating Cost ($)	118,153	118,153	119,303	119,363	117,502	120,395	125,838	125,685	126,060	126,024	125,570	120,318	120,318	117,405	119,303	125,425	123,845	123,270
Crop Value - High Rate of Operating Cost ($/ac)	52.12	52.12	52.37	51.88	51.14	52.76	54.59	53.67	54.81	54.67	54.18	52.12	52.12	51.21	51.76	54.48	52.85	52.33
Crop Value - Low Rate of Operating Cost ($/ac)	54.84	54.89	54.85	54.35	54.99	54.85	54.81	54.95	54.81	54.80	54.93	54.55	54.89	54.72	54.85	54.44	53.85	53.85
Crop Value - Op. & Own Cost - High Rates($)	115,197	116,686	116,859	116,447	116,466	120,826	111,483	118,632	125,463	125,295	124,573	84,619	105,503	108,285	115,476	125,210	68,045	95,395
Crop Value - Op. & Own Cost - Low Rates ($)	112,207	114,999	115,709	117,146	116,729	120,000	113,763	120,625	125,786	125,797	125,570	103,068	110,735	110,218	116,619	125,384	90,695	110,770
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	50.59	50.73	50.81	50.63	50.64	52.53	48.47	51.58	54.57	54.45	54.15	36.79	45.84	47.08	50.21	54.44	29.58	41.48
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	48.79	50.00	50.31	50.93	50.76	52.17	49.46	52.45	54.70	54.70	54.60	44.81	48.15	47.92	50.70	54.51	39.41	48.16

2C - Grain Handling

Enter number (1,2,3,etc.) for # of machines selected for each system in box above machine column (1a,2b etc.)

SYSTEM 1				1							1						1				
SYSTEM 2				1							1						1				
Option	1						2		3			4						5	
Machine Name	Grain Truck or Semi Tractor Trailer						Grain Cart		Grain Auger			Tractor						Cleaner - McLeod	
Selection	1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	4d	4e		5a	5b
Machine Value ($)	110,000	75,000	50,000	30,000	20,000	10000	70,000	40,000	30,000	15,000	5000	250,000	150,000	75,000	50,000	15,000		150,000	100,000
Portion of Investment Financed (%)	70	70	50	50	30	10	50	25	25	10	0	70	50	50	40	10		10	10
Financing Charges - High (%)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10		10	10
Financing Charges - Low (%)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		5	5
Depreciation Rate - High (%)	30	30	20	20	10	10	30	20	20	5	2	30	20	20	10	10		30	20
Depreciation Rate - Low (%)	20	20	10	10	5	5	20	10	10	2	0	10	10	10	5	2		20	10
Financing Cost - High Rate ($/year)	7,700	5,250	2,500	1,500	400	100	3,500	800	1,000	150	0	17,500	7,500	3,750	2,000	150		7,500	5,000
Financing Cost - Low Rate ($/year)	3,850	2,625	1,250	750	200	50	1,750	400	525	75	0	8,750	3,750	1,875	1,000	75		3,750	2,500
Depreciation - High Rate ($/year)	33,000	22,500	10,000	6,000	2,000	1,000	21,000	8,000	7,500	750	0	75,000	30,000	15,000	5,000	1,500		45,000	20,000
Depreciation - Low Rate ($/year)	22,000	15,000	5,000	3,000	1,000	500	14,000	4,000	3,000	300	0	25,000	15,000	7,500	2,500	300		30,000	10,000
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300		2,300	2,300
Area of Crop Windrowed	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070		1,070	1,070
Area of Crop Direct Cut	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,070	1,230		1,230	1,230
Area of Crop Stripped	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560		1,560	1,560
Use - Area of crop per year (ac)	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300		2300	2300
Operating Time - Hiaer Work Rate (h)	115	115	115	153	192	192	115	153	13	20	77	115	115	153	153	24		153	192
Operating Time - Lower Work Rate (h)	230	230	230	230	288	288	153	230	17	24	115	153	153	230	230	24		230	288
Hours of Use for Year	1000	1000	460	460	460	460	288	288	288	48	288	300	300	300	300	300			
Fuel Use Rate- High (L/h)	30	30	30	30	30	30	0	0	0	0	10	30	30	30	25	25		0	0
Fuel Use Rate - Low (L/h)	15	15	15	15	15	15	0	0	0	0	5	20	20	20	15	15			
Loss - High (% of yield)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.5	0.5
Loss - Low (% of yield)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
Work Rate Rate - Higher (ac/h)	20	20	20	15	12	12	20	15	178	115	30	20	20	15	15	115		15	12
Work Rate - Lower (ac/h)	10	10	10	10	8	8	15	10	135	90	20	15	15	10	10	95		10	8
Operator Labour Rate ($/h)	15	15	15	15	15	15	0	0	0	0	0	15	15	15	15	15		0	0
Maintenance Cost Estimate - High Rate($/h)	20	20	15	10	10	10	9	5	20	20	20	20	20	20	15	10		30	30
Maintenance Cost Estimate - Low Rate ($/h)	10	10	5	5	5	5	2	2	5	5	5	10	10	10	5	5		10	10
Cost of fuel - High Rate ($)	2243	2243	2243	2990	3736	0	0	0	0	0	0	2243	2243	2990	2492	325		0	0
Cost of fuel - Low Rate ($)	2243	2243	2243	2243	2803	0	0	0	0	0	0	1953	1953	2990	2243	236		0	0
Cost of Labour - High Rate($)	1725	1725	1725	2300	2875	2875	0	0	0	0	0	1725	1725	2300	2300	300		0	0
Cost of Labour - Low Rate ($)	3450	3450	3450	3450	4313	4313	0	0	0	0	0	2300	2300	3450	3450	363		0	0
Maintenance - High Rate ($)	2300	2300	1725	1533	1917	1917	575	767	261	400	1533	2300	2300	3067	2300	200		4600	5750
Maintenance - Low Rate ($)	2300	2300	1150	1150	1438	1438	307	460	65	121	575	1533	1533	2300	1150	121		2300	2875
Depreciation - High ($/h)	33	23	20	10	5	3	105	40	20	10	1	380	100	55	17	5		293	104
Depreciation - Low ($/h)	22	15	10	6	3	1	70	20	14	0	0	60	50	25	5	1		130	30
Depreciation - High ($/ac)	1.65	1.13	1.35	1.00	0.42	0.21	0.35	2.67	0.18	0.10	0.02	12.50	5.00	3.33	1.11	0.04		19.57	8.70
Depreciation - Low ($/ac)	2.20	1.50	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - Low ($/ac)	2.20	1.50	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - High ($/ac)	2.20	1.50	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - Low ($/ac)	1.43	1.00	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - High ($/ac)	2.20	1.50	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - Low ($/ac)	1.43	1.00	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - High ($/ac)	2.20	1.50	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Depreciation - Low ($/ac)	1.43	1.00	1.35	0.78	0.31	0.10	4.67	2.00	0.10	0.00	0.00	5.00	3.33	3.33	0.56	0.01		13.04	4.35
Finance Costs - High Rate ($/h)	7.70	5.25	2.50	3.75	1.00	0.25	17.50	4.00	4.33	3.75	0.00	29.17	12.50	6.25	3.33	0.25		16.30	8.70
Finance Costs - Low Rate ($/h)	3.85	2.63	3.13	1.88	0.50	0.13	8.75	2.00	2.10	1.88	0.00	2.92	1.25	0.83	0.44	0.00		3.26	2.17
Finance Costs - High Rate ($/ac)	0.39	0.28	0.31	0.25	0.09	0.02	0.58	0.20	0.02	0.02	0.00	1.94	0.83	0.63	0.33	0.00		1.63	1.09
Finance Costs - Low Rate ($/ac)	0.39	0.28	0.31	0.19	0.05	0.02	0.58	0.20	0.02	0.02	0.00	1.94	0.83	0.63	0.33	0.00		1.63	1.09
Maintenance Cost - High Rate ($/ac)	1.00	1.00	0.75	0.67	0.83	0.83	0.25	0.33	0.11	0.17	0.67	1.00	1.00	1.33	1.00	0.09		2.00	2.90
Maintenance Cost - Low Rate ($/ac)	1.00	1.00	0.50	0.50	0.63	0.63	0.13	0.20	0.04	0.05	0.25	0.67	0.67	1.00	0.50	0.05		1.00	1.25
Labour Cost - High Rate ($/ac)	0.75	0.75	0.75	1.00	1.25	1.25	0.00	0.00	0.00	0.00	0.00	0.75	0.75	1.00	1.00	0.13		0.00	0.00
Labour Cost - Low Rate ($/ac)	1.50	1.50	1.50	1.50	1.88	1.88	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.50	1.50	0.18		0.00	0.00
Operating Costs - High Rate ($/h)	54.50	54.50	49.50	44.50	44.50	39.50	0.00	0.00	39.50	39.50	39.50	54.50	54.50	49.50	39.50	39.75		10.00	10.00
Operating Costs - Low Rate ($/h)	34.75	34.75	29.75	29.75	29.75	29.00	2.50	2.50	6.00	6.00	6.00	35.00	35.00	29.00	29.75	29.75		10.00	10.00
Operating Costs - High Rate ($/ac)	2.70	2.70	2.48	2.97	3.71	2.58	0.36	0.35	0.11	0.17	0.67	2.70	2.70	3.00	3.00	0.35		2.60	2.89
Operating Costs - Low Rate ($/ac)	3.48	3.48	2.98	2.98	3.72	2.58	0.13	0.20	0.04	0.05	0.25	2.80	2.80	3.00	2.98	0.21		1.60	1.25
Running & Operating Costs - High Rates ($/h)	54.50	52.25	49.75	45.25	45.09	27.75	137.50	40.00	59.50	42.50	39.50	382.50	170.00	117.50	80.00	40.75		372.39	109.43
Running & Operating Costs - Low Rates ($/h)	69.40	62.39	45.39	39.13	32.75	21.35	69.75	24.50	21.10	11.30	6.00	160.00	100.00	69.25	41.40	31.00		198.74	53.48
Running & Operating Costs - High Rates ($/ac)	4.76	4.11	4.04	4.32	4.31	2.31	6.39	3.27	0.39	0.27	0.08	10.14	6.98	7.50	4.69	0.41		24.83	13.37
Running & Operating Costs - Low Rates ($/ac)	6.06	5.24	4.04	3.81	4.59	2.67	6.39	3.40	0.18	0.15	0.20	10.03	6.70	6.93	4.14	0.33		15.67	6.66
Gross Value Grain Crop Based Loan Method ($)	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785		450785	450785
Cost of Crop Production $	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640		324640	324640
Value of Grain Loss - High Rate ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		2254	2254
Value of Grain Loss - Low Rate ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
Crop Value - High Rate of Operating Cost ($/ac)	52.12	52.12	52.37	51.88	51.14	52.79	54.68	54.51	54.73	54.67	54.18	50.12	52.12	51.21	51.79	54.49		52.66	52.35
Crop Value - Low Rate of Operating Cost ($/ac)	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65	54.65		54.65	54.65
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	52.09	49.75	49.64	49.80	50.04	52.53	49.47	51.89	54.59	54.49	54.16	39.75	49.67	47.99	50.21	54.44		30.02	41.49
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	49.78	49.01	49.51	49.65	49.79	52.17	49.45	52.01	54.58	54.58	54.58	41.51	49.15	47.92	50.35	54.52		39.17	48.15

2D - Straw and Chaff

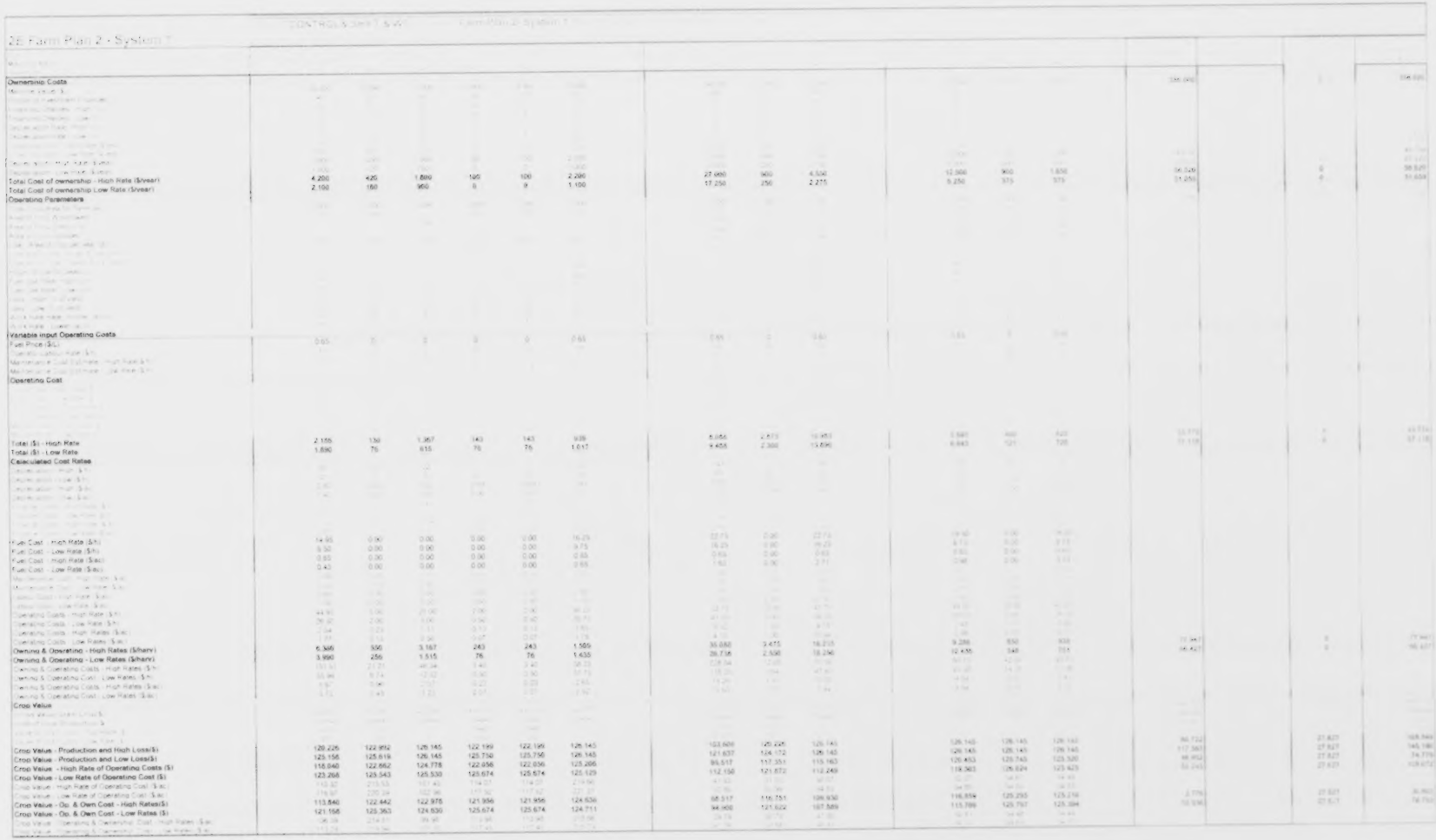
SYSTEM 1
SYSTEM 2

Ownership Costs																			
Total Cost of ownership - High Rate ($/year)	1,700	0	0	7,500	3,600	0	32,400	5,250	1,800	0	14,650	3,000	37,000	15,000	4,500	18,700	9,750	5,200	2,200
Total Cost of ownership Low Rate ($/year)	850	0	0	3,750	1,800	0	16,200	2,625	900	0	7,425	750	23,500	7,500	2,250	11,475	4,875	2,600	1,100
Operating Parameters																			
Variable Input Operating Costs																			
Operating Cost																			
Total ($) - High Rate	169	169	338	4450	4450	7690	1253	3760	3760	3760	1350	925	5943	3943	6462	3742	3742	5616	5060
Total ($) - Low Rate	169	169	338	6458	6458	10656	925	3083	3083	3083	1542	771	7830	7830	3915	3684	3684	5504	5504
Calculated Cost Rates																			
Fuel Cost - High Rate ($/h)	0.00	0.00	0.00	19.50	19.50	25.50	0.00	0.00	0.00	0.00	0.00	0.00	29.25	29.25	29.25	19.50	19.50	19.25	19.25
Fuel Cost - Low Rate ($/h)	0.00	0.00	0.00	9.75	9.75	12.75	0.00	0.00	0.00	0.00	0.00	0.00	13.00	13.00	13.00	9.75	9.75	9.75	9.75
Fuel Cost - High Rate ($/ac)	0.00	0.00	0.00	0.65	0.65	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.65	0.65	0.65	0.65	0.64	0.64
Fuel Cost - Low Rate ($/ac)	0.00	0.00	0.00	1.30	1.30	2.55	0.00	0.00	0.00	0.00	0.00	0.00	1.30	1.30	0.65	0.65	0.65	0.90	0.90
Operating Costs - High Rate ($/h)	2.50	2.50	2.50	22.50	22.50	41.50	20.00	20.00	20.00	20.00	10.00	10.00	34.25	34.25	34.25	22.50	22.50	31.25	31.25
Operating Costs - Low Rate ($/h)	1.25	1.25	1.25	26.75	26.75	29.75	20.00	20.00	20.00	20.00	10.00	10.00	38.00	38.00	38.00	26.75	26.75	26.75	26.75
Operating Costs - High Rates ($/ac)	0.19	0.19	0.25	2.60	2.60	4.95	1.67	1.67	1.67	1.67	0.83	1.42	3.85	3.85	3.85	2.60	2.60	3.48	3.48
Operating Costs - Low Rates ($/ac)	0.09	0.09	0.09	3.09	3.09	3.55	1.67	1.67	1.67	1.67	0.83	1.42	4.25	4.25	4.25	3.09	3.09	3.48	3.48
Owning & Operating - High Rates ($/Harv)	1,869	169	338	8,675	6,475	7,690	33,653	5,950	5,560	3,760	16,256	3,825	37,250	18,495	7,745	8,904	6,475	5,419	5,992
Owning & Operating - Low Rates ($/Harv)	1,019	169	338	10,985	5,531	10,656	17,125	5,708	3,983	3,883	8,967	1,521	28,325	13,565	5,248	8,387	5,673	7,107	6,182
Owning & Operating - High Rates ($/h)	22.50	2.50	2.50	77.00	57.50	65.50	144.54	45.38	29.73	20.00	170.54	42.41	422.57	198.48	113.03	77.00	57.50	56.48	45.38
Owning & Operating - Low Rates ($/h)	8.02	1.25	1.25	45.50	26.75	29.75	130.14	43.53	12.92	7.00	94.18	8.95	151.71	72.43	36.73	45.50	26.75	34.43	32.43
Owning & Operating - High Rates ($/ac)	1.11	0.19	0.25	5.12	1.83	4.55	3.19	0.84	0.97	2.00	0.78	2.12	20.13	9.46	5.39	5.12	1.83	3.99	3.19
Owning & Operating - Low Rates ($/ac)	0.50	0.19	0.25	6.50	3.11	9.55	3.25	1.06	0.75	1.67	4.09	0.50	13.51	7.54	3.04	3.53	1.97	3.99	3.19
Crop Value																			
Crop Value - Production and High Loss($)	6,130	6,130	6,130	6,130	6,130	6,130	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697
Crop Value - Production and Low Loss($)	6,130	6,130	6,130	6,130	6,130	6,130	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697	21,697
Crop Value - High Rate of Operating Costs ($)	5,961	5,961	5,792	5,792	5,792	5,792	20,464	17,997	17,997	17,997	20,310	20,772	15,754	15,754	17,295	17,955	17,955	17,581	16,610
Crop Value - Low Rate of Operating Cost ($)	5,961	5,961	5,792	-328	-328	-3,926	20,772	18,614	18,614	18,614	20,155	20,926	14,967	14,967	16,182	18,028	18,028	16,193	16,193
Crop Value - High Rate of Operating Cost- $/ac	1.62	1.62	1.62	1.62	1.62	1.62	11.06	9.72	9.72	9.72	10.96	11.22	8.51	8.51	9.34	9.70	9.70	9.50	8.97
Crop Value - Low Rate of Operating Cost- $/ac	1.62	1.62	1.62	1.62	1.62	1.62	11.22	10.06	10.06	10.06	10.89	11.31	8.09	8.09	8.74	9.74	9.74	8.75	8.75
Crop Value - Op. & Own Cost - High Rates($)	4,261	5,961	5,792	-2,545	-348	-1,560	-11,936	12,747	16,197	17,997	5,460	17,772	-15,541	3,199	13,952	12,713	15,222	16,278	15,705
Crop Value - Op. & Own Cost - Low Rates ($)	5,111	5,961	5,792	-4,855	-2,501	-3,926	-4,572	15,969	17,714	18,614	12,730	20,176	-6,628	8,112	16,453	12,310	16,024	14,596	15,515
Crop Value - Operating & Ownership Cost - High Rates- $/ac	0.92	1.62	1.62	1.62	1.62	1.62	11.06	9.72	9.72	9.72	10.96	11.22	8.51	8.51	9.34	9.70	9.70	9.50	8.97
Crop Value - Operating & Ownership Cost - High Rates- $/ac	0.92	1.62	1.62	1.62	1.62	1.62	11.06	9.72	9.72	9.72	10.96	11.22	8.51	8.51	9.34	9.70	9.70	9.50	8.97

2D - Straw and Chaff

Enter number (1,2,3, etc) for # of machines selected for each system in box above machine column (1a, 2b, etc)

SYSTEM 1																			
SYSTEM 2			1			1			1								1		
	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d
Option	1			2			3				4		5			6			
Machine Name	Chaff Collector			Chaff Truck			Baler				Bale Mover		Semi Tractor Trailer			Tractor			
Selection	1a	1b	1c	2a	2b	2c	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d
Machine Value ($)	10,000	6,000	3500	50,000	30,000	10,000	120,000	35,000	15,000	5000	55,000	25,000	100,000	60,000	30,000	85,000	65,000	40,000	20,000
Portion of Investment Financed (%)	70	0	0	50	20	0	70	50	20	0	70	20	70	50	50	70	50	30	10
Financing Charges - High (%)	10	10	10	10	10	0	10	10	10	0	10	10	10	10	10	10	10	10	10
Financing Charges - Low (%)	5	5	5	5	5	0	5	5	5	0	5	5	5	5	5	5	5	5	5
Depreciation Rate - High (%)	10	0	0	10	10	0	20	10	10	0	20	10	30	20	10	15	10	10	10
Depreciation Rate - Low (%)	5	0	0	5	5	0	10	5	5	0	10	2	20	10	5	10	5	5	5
Financing Cost - High Rate ($/year)	700	0	0	2,500	600	0	8,400	1,750	300	0	3,850	500	7,000	3,000	1,500	5,950	3,250	1,200	200
Financing Cost - Low Rate ($/year)	350	0	0	1,250	300	0	4,200	875	150	0	1,925	250	3,500	1,500	750	2,975	1,625	600	100
Depreciation - High Rate ($/year)	1,000	0	0	5,000	3,000	0	24,000	3,500	1,500	0	11,000	2,500	30,000	12,000	3,000	12,750	6,500	4,000	2,000
Depreciation - Low Rate ($/year)	500	0	0	2,500	1,500	0	12,000	1,750	750	0	5,500	500	20,000	6,000	1,500	8,500	3,250	2,000	1,000
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
Area of Crop Windrowed	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070
Area of Crop Direct Cut	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230
Area of Crop Stripped	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550	1,550
Use - Area of crop per year (ac)	1660	1660	1660	1660	1660	1660	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Operating Time - Higer Work Rate (h)	85	85	169	113	113	169	62	185	185	185	93	93	93	93	69	84	84	93	123
Operating Time - Lower Work Rate (h)	169	169	338	241	241	338	93	308	308	308	154	154	185	185	93	123	123	185	185
Hours of Use for Year				200	200	300							500	500	300	300	300	300	300
Fuel Use Rate- High (L/h)	0	0	0	30	30	30	0	0	0	0	0	0	45	45	45	30	30	25	25
Fuel Use Rate - Low (L/h)	0	0	0	15	15	15	0	0	0	0	0	0	20	20	20	15	15	15	15
Loss - High (% of yield)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loss - Low (% of yield)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work Rate Rate - Higher (ac/h)	20	20	10	15	15	10	30	10	10	10	20	20	20	20	27	22	22	20	15
Work Rate - Lower (ac/h)	10	10	5	7	7	5	20	6	6	6	12	12	10	10	20	15	15	10	10
Operator Labour Rate ($/h)	0	0	0	15	15	15	0	0	0	0	0	0	15	15	15	15	15	15	15
Maintenance Cost Estimate - High Rate($/h)	2	2	2	5	5	5	20	20	20	20	15	10	20	20	20	10	10	10	10
Maintenance Cost Estimate - Low Rate ($/h)	1	1	1	2	2	2	10	10	10	10	10	5	10	10	10	5	5	5	5
Cost of fuel - High Rate ($)	0	0	0	2197	2197	4310	0	0	0	0	0	0	2706	2706	2004	1640	1640	1503	2004
Cost of fuel - Low Rate ($)	0	0	0	2354	2354	4310	0	0	0	0	0	0	2405	2405	1203	1203	1203	1804	1804
Cost of Labour - High Rate($)	0	0	0	1690	1690	2535	0	0	0	0	0	0	1388	1388	1028	1261	1261	1388	1850
Cost of Labour - Low Rate ($)	0	0	0	3621	3621	5070	0	0	0	0	0	0	2775	2775	1388	1850	1850	2775	2775
Maintenance - High Rate ($)	169	169	338	563	563	845	1233	3700	3700	3700	1388	925	1850	1850	1370	841	841	925	1233
Maintenance - Low Rate ($)	169	169	338	483	483	676	925	3083	3083	3083	1542	771	1850	1850	925	617	617	925	925
Depreciation - High ($/h)	12	0	0	25	15	0	360	19	8	0	110	27	324	130	44	43	22	13	7
Depreciation - Low ($/h)	3	0	0	13	8	0	120	6	2	0	36	3	108	32	10	28	11	7	3
Depreciation - High ($/ac)	0.58	0.00	0.00	1.87	1.00	0.00	12.87	1.89	0.81	0.00	5.96	1.35	10.22	0.49	1.62	1.93	0.98	0.57	0.44
Depreciation - Low ($/ac)	0.30	0.00	0.00	1.79	1.07	0.00	6.49	0.95	0.41	0.00	2.97	0.37	10.81	3.24	0.81	1.89	0.72	0.67	0.33
Finance Costs - High Rate ($/h)	8	0	0	13	3	0	136	9	2	0	42	5	14	6	5	20	11	4	1
Finance Costs - Low Rate ($/h)	2	0	0	6	2	0	45	3	0	0	12	2	7	3	3	10	5	2	0
Finance Costs - High Rate ($/ac)	0.41	0.00	0.00	0.83	0.20	0.00	4.54	0.96	0.16	0.00	2.08	0.27	0.70	0.30	0.19	0.90	0.49	0.20	0.04
Finance Costs - Low Rate ($/ac)	0.21	0.00	0.00	0.89	0.21	0.00	2.27	0.47	0.08	0.00	1.04	0.14	0.70	0.30	0.13	0.85	0.36	0.20	0.03
Maintenance Cost - High Rate ($/ac)	0.10	0.10	0.20	0.33	0.33	0.50	0.67	2.00	2.00	2.00	0.75	0.50	1.00	1.00	0.74	0.45	0.45	0.50	0.67
Maintenance Cost - Low Rate ($/ac)	0.10	0.10	0.20	0.29	0.29	0.40	0.50	1.67	1.67	1.67	0.83	0.42	1.00	1.00	0.50	0.33	0.33	0.50	0.50
Labour Cost - High Rate ($/ac)	0.00	0.50	0.00	1.00	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.75	0.68	0.68	0.68	0.75	1.00
Labour Cost - Low Rate ($/ac)	0.00	0.00	0.00	2.14	2.14	3.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	0.75	1.00	1.00	1.50	1.50
Operating Costs - High Rate ($/h)	2.00	2.00	2.00	39.00	28.00	45.00	28.00	28.00	28.00	20.00	10.00	10.00	64.25	64.25	64.25	44.00	44.00	41.25	41.25
Operating Costs - Low Rate ($/h)	1.00	1.00	1.00	26.75	26.75	26.75	10.00	10.00	10.00	10.00	10.00	5.00	36.00	36.00	36.00	29.75	29.75	29.75	29.75
Operating Costs - High Rates ($/ac)	0.10	0.10	0.20	2.63	2.63	4.50	0.67	2.00	2.00	2.00	0.75	0.50	3.21	3.21	2.36	2.02	2.02	2.06	2.75
Operating Costs - Low Rates ($/ac)	0.10	0.10	0.20	3.62	3.62	5.05	0.50	1.67	1.67	1.67	0.83	0.42	3.60	3.60	1.50	1.96	1.96	2.06	2.06
Operating & Ownership Costs - High Rates ($/h)	22.13	2.60	2.60	77.00	67.50	45.00	646.41	48.38	28.75	20.00	175.04	48.43	402.67	160.88	113.63	108.83	77.00	59.02	48.50
Operating & Ownership Cost - Low Rates ($/h)	6.03	1.00	1.00	46.50	36.75	28.75	105.14	18.51	12.92	10.00	69.10	9.00	153.11	73.43	66.72	66.00	46.00	36.42	33.42
Operating & Ownership Costs - High Rates ($/ac)	1.11	0.10	0.20	5.13	3.63	4.55	18.16	4.84	2.97	2.00	9.76	2.12	20.13	10.00	4.19	4.66	3.90	2.93	3.34
Operating & Ownership Cost - Low Rates ($/ac)	0.59	0.10	0.20	6.60	5.11	5.05	9.30	3.69	2.15	1.67	4.85	0.62	15.31	7.34	2.84	4.03	3.07	3.04	3.34
Gross Value MOG Crop ($)	6130	6130	6130	6130	6130	6130	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697	21697
Cost of Crop Production $	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Value of Grain Loss - High Rate ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Value of Grain Loss - Low Rate ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crop Value - High Rate of Operating Cost ($/ac)	3.63	3.63	3.43	0.00	0.00	-0.02	11.06	9.73	9.73	9.73	10.00	11.23	8.02	8.02	8.36	9.71	9.71	9.67	9.00
Crop Value - Low Rate of Operating Cost ($/ac)	3.63	3.63	3.63	3.63	3.63	3.63	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73	11.73
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	2.52	3.53	3.43	-1.51	-0.21	-0.02	-6.46	6.89	6.76	9.73	2.68	9.61	-6.40	1.73	7.54	6.67	6.23	6.69	6.40
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	3.02	3.53	3.43	-2.07	-1.48	-2.32	2.47	8.84	9.57	10.06	6.89	10.61	-3.99	4.39	8.89	7.19	8.66	7.69	8.39



2E Farm Plan 2 - System 1

Press "CONTROL& SHIFT & W" to transfer Farm Plan 2- System 1 Machinery Selection to this Summary Sheet

Option	1						2			3			FP2 -SYS 1 Summary Grain Only	4	FP2 -SYS 1 Summary MOG Only	FP2 -SYS 1 Summary Grain & MOG
Machine Name	Cultivation - Gathering Equipment						Harvesting Equipment			Grain Handling Equipment				Straw and Chaff Equipment		
Selection	1c	2b	3b	4b	6b	7c	1f	2c	4d	1c	3b	4a				
Machine Value ($)	30,000	6,000	15,000	5,000	6,000	20,000	190,000	10,000	35,000	90,000	15,000	15,000				
Portion of Investment Financed (%)	40	20	20	0	0	10	30	10	30	10	10	10				
Financing Charges - High (%)	10	10	10	10	10	10	10	10	10	8	8	8				
Financing Charges - Low (%)	5	5	5	5	5	5	5	5	5	5	5	5				
Depreciation Rate - High (%)	10	5	10	2	2	10	15	5	10	20	5	10				
Depreciation Rate - Low (%)	5	2	5	0	0	5	10	2	5	10	2	2				
Financing Cost - High Rate ($/year)	1,200	120	300	0	0	200	4,500	100	1,050	2,500	150	150	10270		0	10,270
Financing Cost - Low Rate ($/year)	600	60	150	0	0	100	2,250	50	525	1,250	75	75	5138		0	5,138
Depreciation - High Rate ($/year)	3,000	300	1,500	100	120	2,000	22,500	500	3,500	18,000	750	1,500	48750		0	48,750
Depreciation - Low Rate ($/year)	1,500	120	750	0	0	1,000	15,000	200	1,750	9,000	300	300	28800		0	28,800
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2300		1,860	2300
Area of Crop Windrowed	1,070	1,070		1,070	1,070	1,070	1,070	1,070	1,070	1,230	1,230	1,230				
Area of Crop Direct Cut			1,230				1,230			1,070	1,070	1,070				
Area of Crop Stripped							1,860		1,550	1,980	1,980	1,980				
Use - Area of crop per year (ac)	1070	570	1230	1070	1070	570	2300	2300	2300	2300	2300	2300				
Operating Time - Hoper Work Rate (h)	40	26	68	71	71	26	153	288	230	115	20	20	1137		0	1137
Operating Time - Lower Work Rate (h)	71	38	123	153	153	38	230	460	383	230	24	24	1928		0	1928
Hours of Use for Season						100			200	400	40	200				
Fuel Use Rate- High (L/h)	23	0	0	0	0	25	35	0	35	30	0	25				
Fuel Use Rate - Low (L/h)	10	0	0	0	0	15	25	0	25	15	0	15				
Loss - High (% of yield)	3	3	2.5	2	2	0	5	3	0	0	0	0				
Loss - Low (% of yield)	0.5	0.5	1	0.2	0.2	0	1	1	0	0	0	0				
Work Rate Rate - Higher (ac/h)	22	22	18	15	15	22	15	8	10	20	115	115				
Work Rate - Lower (ac/h)	15	15	10	7	7	15	10	5	6	10	95	95				
Operator Labour Rate ($/h)	15	0	0	0	0	15	15	0	15	15	0	15				
Maintenance Cost Estimate - High Rate($/h)	15	5	20	2	2	5	15	10	10	5	20	10				
Maintenance Cost Estimate - Low Rate ($/h)	5	2	5	0.5	0.5	2	10	5	5	5	5	5				
Cost of fuel - High Rate ($)	727	0	0	0	0	421	3488	0	5233	2243	0	325	12436		0	12436
Cost of fuel - Low Rate ($)	464	0	0	0	0	371	3738	0	6229	2243	0	236	13279		0	13279
Cost of Labour - High Rate($)	730	0	0	0	0	380	2300	0	3450	1725	0	300	8893		0	8893
Cost of Labour - Low Rate ($)	1070	0	0	0	0	570	3450	0	5750	3450	0	363	14653		0	14653
Maintenance - High Rate ($)	730	130	1367	143	143	130	2300	2875	2300	1725	400	200	12441		0	12441
Maintenance - Low Rate ($)	357	76	615	76	76	76	2300	2300	1917	1150	121	121	9185		0	9185
Depreciation - High ($/h)	45	12	22	1	1	20	147	2	18	23	10	5				
Depreciation - Low ($/h)	21	3	9	0	0	10	65	0	9	13	8	1				
Depreciation - High ($/ac)	2.80	0.89	1.25	0.69	0.69	0.91	0.79	0.22	1.79	1.25	0.19	0.04				
Depreciation - Low ($/ac)	1.40	0.31	0.91	0.00	0.00	0.67	0.52	0.00	1.48	1.25	0.09	0.01				
Finance Costs - High Rate ($/h)	25	5	4	0	0	2	29	0	5	0.25	3.75	0.50				
Finance Costs - Low Rate ($/h)	8	2	1	0	0	1	10	0	3	3.13	1.88	0.25				
Finance Costs - High Rate ($/ac)	1.12	0.21	0.34	0.00	0.00	0.09	1.96	0.04	0.53	0.31	0.03	0.00				
Finance Costs - Low Rate ($/ac)	0.36	0.11	0.12	0.00	0.00	0.07	0.98	0.02	0.44	0.31	0.02	0.00				
Maintenance Cost - High Rate ($/ac)	0.68	0.23	1.11	0.13	0.13	0.23	1.00	1.35	1.00	0.75	0.17	0.09				
Maintenance Cost - Low Rate ($/ac)	0.33	0.13	0.50	0.07	0.07	0.13	1.00	1.00	0.83	0.75	0.08	0.05				
Labour Cost - High Rate ($/ac)	0.68	0.00	0.00	0.00	0.00	0.68	1.00	0.00	1.50	1.50	0.00	0.13				
Labour Cost - Low Rate ($/ac)	1.00	0.00	0.00	0.00	0.00	1.00	1.50	0.00	2.50	1.50	0.00	0.16				
Operating Costs - High Rate ($/ac)	44.58	5.89	35.60	2.89	2.89	54.35	68.79	16.00	47.79	49.50	26.00	41.25				
Operating Costs - Low Rate ($/ac)	26.39	2.89	6.39	0.89	0.89	28.79	41.25	5.00	36.39	28.75	6.89	29.75				
Operating Costs - High Rate ($/ac)	2.84	0.89	1.11	0.13	0.13	1.65	3.82	1.35	4.78	2.48	0.17	0.38				
Operating Costs - Low Rate ($/ac)	1.77	0.13	0.89	0.07	0.07	1.76	4.13	1.00	6.04	2.88	0.08	0.31				
Machine & Operating Costs - High Rate ($/ac)	101.31	31.21	48.34	3.40	3.40	59.35	220.94	13.69	79.59	68.75	42.80	48.75				
Machine & Operating Cost - Low Rate ($/ac)	58.65	6.74	18.32	0.93	0.93	37.75	118.39	8.54	47.83	46.39	14.38	31.00				
Machine & Operating Costs - High Rate ($/ac)	5.67	0.93	2.57	0.33	0.33	2.68	16.39	1.91	7.83	4.84	0.37	0.41				
Machine & Operating Cost - Low Rate ($/ac)	3.73	0.46	1.89	0.07	0.07	2.52	11.65	1.11	7.24	4.84	0.15	0.32				
Gross Value Grain Crop($)	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	460,785		27827	478,612
Cost of Crop Production $	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324,640		0	324,640
Value of Grain Loss - High Rate ($)	5919	3183	0	3948	3948	0	22539	5919	0	0	0	0	45423		0	45423
Value of Grain Loss - Low Rate ($)	987	526	0	395	395	0	4508	1973	0	0	0	0	8782		0	8782
Gross Value - Machine & Operating Cost - High Rates ($/ac)	146.00	214.01	99.95	113.89	113.89	218.69	289.79	98.78	47.39	68.84	84.49	90.44				
Gross Value - Operating & Consumable Cost - Low Rates ($/ac)	113.34	218.94	101.33	117.45	117.45	219.79	41.39	92.59	49.91	68.91	84.63	84.32				

Ownership Costs																								
Total Cost of ownership - High Rate (Silver)	4,230	425	1,500	100	100	2,200		27,900	500	4,500		12,400	400	1,800		96,000	0	0	1,500	3,000		1,000		93,000
Total Cost of ownership Low Rate (Silver)	2,100	160	800	0	0	1,100		17,200	250	2,275		4,250	375	375		33,000	0	0	800	2,000		1,500		34,500
Operating Parameters																								
Variable Head Operating Costs																								
Fuel Price $ L	0.60	0	0	0	0	0.60		1.00	0	1.00		1.00	0	1.00			0	0	0	0				
Operating Cost																								
Total ($) - High Rate	2,100	150	1,357	143	143	939		8,000	1,875	10,800		3,900	900	825		22,000	0	1,000	2,700	5,000		3,000		48,000
Total ($) - Low Rate	1,890	75	515	75	75	1,017		8,450	2,000	13,645		5,643	937	720		27,000	0	1,000	4,000	7,000		4,000		58,000
Calculated Cost Rates																								
Fuel Cost - High Rate $ L	0.45	0.30	0.90	0.30	0.30	0.45		0.75	0.75	0.75		0.75	0.75	0.75		0.75	0.00	0.00	0.00	0.00				
Fuel Cost - Low Rate $ L	0.30	0.30	0.30	0.30	0.30	0.60		0.50	0.50	0.50		0.50	0.50	0.50		0.50	0.00	0.00	0.00	0.00				
Fuel Cost - High Rate $ kL	0.45	0.30	0.90	0.30	0.30	0.45		0.75	0.75	0.75		0.75	0.75	0.75		0.75	0.00	0.00	0.00	0.00				
Fuel Cost - Low Rate $ kL	0.41	0.30	0.90	0.30	0.30	0.60		0.50	0.50	0.50		0.50	0.50	0.50		0.50	0.00	0.00	0.00	0.00				
Operating Cost - High Rate $ L																								
Operating Cost - Low Rate $ L																								
Operating Cost - High Rate $ kL																								
Operating Cost - Low Rate $ kL																								
Owners & Operating Costs - High Rates ($/yr)	6,330	580	3,157	243	243	1,939		33,000	3,475	19,275		8,245	850	900		27,000	100	1,000	3,000	3,478		13,000		96,000
Owners & Operating Cost - Low Rates ($/yr)	3,990	206	1,315	75	75	1,435		25,750	2,500	14,290		10,436	843	720		33,000	100	1,000	4,800	7,107		17,000		97,000
Operating Cost - High Rates $ L																								
Operating Cost - Low Rates $ L																								
Operating Cost - High Rates $ kL																								
Operating Cost - Low Rates $ kL																								
Crop Value																								
Crop Value - Production and High Loss($)	120,295	122,992	126,145	122,190	122,190	126,145		103,605	120,225	126,145		129,110	126,145	126,145		90,720	6,132	6,132	21,887	21,887		27,027		126,000
Crop Value - Production and Low Loss($)	123,150	125,614	126,145	125,790	125,790	126,145		121,837	124,172	126,145		126,145	126,145	126,145		117,360	6,132	6,132	21,887	21,887		27,027		126,000
Crop Value - High Rate of Operations Costs ($)	115,240	122,852	124,778	122,095	122,095	125,205		90,517	117,351	115,183		120,410	125,745	125,220		90,000	5,750	5,750	21,887	17,887		12,284		96,716
Crop Value - Low Rate of Operations Cost ($)	120,256	125,343	125,530	125,674	125,674	125,724		112,190	121,672	112,849		116,503	125,924	125,405		90,000	5,750	5,908	13,914	14,193		3,346		96,716
Crop Value - High Rate of Operations Cost ($/yr)																								
Crop Value - Low Rate of Operations Cost ($/yr)																								
Crop Value - Ow. & Oper.Cost - High Rates($)	113,540	122,442	122,878	121,895	121,895	124,538		86,917	116,751	108,450		114,898	125,289	125,210		72,720	5,750	5,560	18,187	18,275		3,561		51,716
Crop Value - Ow. & Oper.Cost - Low Rates ($)	121,156	125,363	124,830	125,674	125,674	124,711		93,900	121,622	107,559		103,709	125,767	125,264		90,000	5,750	5,908	11,714	13,986		5,347		51,716

2F Farm Plan 2 - System 2

Press "CONTROL & SHIFT & X" to transfer Farm Plan 2 - System 2 Machinery Selection to this Summary Sheet

Option	1						2			3			FP2-SYS2 Summary Grain Only	4				FP2-SYS2 Summary MOG Only	FP2-SYS2 Summary Grain & MOG
Machine Name	Cutter - Gatherine Equipment						Harvester Equipment			Grain Handling Equipment				Straw and Chaff Equipment					
Selection	1c	2b	3b	4b	5b	7c	1d	2c	4d	1c	3b	4a		1c	2c	3c	6c		
Machine Value ($)	30,000	6,000	10,000	5,000	5,000	20,000	180,000	10,000	35,000	60,000	10,000	10,000		3600	10,000	10,000	40,000		
Portion of Investment Financed (%)	40	20	20	0	0	10	30	10	30	60	10	10		0	0	20	30		
Financing Charges - High (%)	10	10	10	10	10	10	10	10	10	10	10	10		10	0	10	10		
Financing Charges - Low (%)	5	5	5	5	5	5	6	5	5	5	5	5		5	0	5	5		
Financing Charges - Low (%)	10	5	10	2	2	10	15	5	10	20	5	10		0	0	10	10		
Depreciation Rate - High (%)	5	2	5	0	0	5	10	2	5	10	2	2		0	0	5	5		
Depreciation Rate - Low (%)	1,200	120	500	0	0	200	4,500	100	1,050	2,500	150	150	10270	0	0	300	1,200	1,500	11,770
Financing Cost - High Rate ($/year)	600	60	180	0	0	100	2,250	50	525	1,200	75	75	5135	0	0	150	600	750	5,885
Financing Cost - Low Rate ($/year)	2,000	300	1,000	100	100	2,000	22,500	500	3,500	10,000	750	1,500	467500	0	0	1,500	4,000	5,500	91,350
Depreciation - High Rate ($/year)	1,500	120	750	0	0	1,000	15,000	200	1,750	5,000	300	300	20820	0	0	750	2,000	2,750	23,570
Depreciation - Low Rate ($/year)																			
Total Crop Area for Farm (ac)	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2300	2,300	2,300	2,300	2,300	1,880	2300
Area of Crop Windrowed	1,070	1,070		1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070	1,070		1,070	1,070	1,070	1,070		
Area of Crop Direct Cut			1,230				1,230			1,230	1,230	1,230		1,230	1,230	1,230	1,230		
Area of Crop Stripped							1,580		1,580	1,580	1,580	1,580		1,580	1,580	1,580	1,580		
Use - Area of crop per year (ac)	1070	570	1230	1070	1070	570	2300	2300	2300	2300	2300	2300		1580	1580	1580	1580		
Operating Time - Hoger Work Rate (h)	49	26	68	71	71	26	153	266	230	115	20	20	1131	106	106	185	93	616	1753
Operating Time - Lower Work Rate (h)	71	38	123	153	153	38	230	460	383	230	24	24	1329	338	338	308	185	1169	3097
Hours of Use for Season						100			200	460	40	320			300		300		
Fuel Use Rate - High (L/h)	23	0	0	0	0	26	35	0	35	30	0	26		0	30	0	25		
Fuel Use Rate - Low (L/h)	10	0	0	0	0	15	25	0	25	15	0	15		0	15	0	15		
Loss - High (% of yield)	3	3	2.5	2	2	0	5	3	0	0	0	0		0	0	0	0		
Loss - Low (% of yield)	0.5	0.5	1	0.2	0.2	0	1	1	0	0	0	0		0	0	0	0		
Work Rate Rate - Higher (ac/h)	22	22	18	15	15	22	15	9	10	20	115	115		10	10	10	20		
Work Rate - Lower (ac/h)	15	15	10	7	7	15	10	5	5	10	95	95		5	5	5	10		
Operator Labour Rate ($/h)	15	0	0	0	0	15	15	0	15	15	0	15		0	15	0	15		
Maintenance Cost Estimate - High Rate($/h)	15	5	20	2	2	5	15	10	10	15	20	10		2	5	20	10		
Maintenance Cost Estimate - Low Rate ($/h)	5	2	5	0.5	0.5	2	10	5	5	5	5	5		1	2	10	5		
Cost of fuel - High Rate ($)	727	0	0	0	0	421	3488	0	5233	2243	0	326	12436	0	4310	0	1503	5813	16249
Cost of fuel - Low Rate ($)	454	0	0	0	0	371	3736	0	5229	2243	0	236	13278	0	4310	0	1504	5113	14393
Cost of Labour - High Rate($)	730	0	0	0	0	368	2300	0	3450	1725	0	300	9583	0	2535	0	1368	3623	12516
Cost of Labour - Low Rate ($)	1070	0	0	0	0	570	3450	0	5750	3450	0	450	14950	0	5070	0	2775	7845	22485
Maintenance - High Rate ($)	730	130	1367	143	143	130	2300	2875	2300	1725	400	200	12441	335	845	3700	925	5805	18246
Maintenance - Low Rate ($)	357	75	615	76	76	76	2300	2300	1917	1150	121	121	9185	335	676	3583	925	5020	14205
Depreciation - High ($/h)	62	12	22	1	1	20	147	2	18	25	10	5		0	0	5	13		
Depreciation - Low ($/h)	21	3	6	0	0	10	66	0	9	13	5	1		0	0	2	7		
Depreciation - High ($/ac)	2.89	0.53	1.78	0.09	0.09	0.91	0.78	0.02	1.78	1.25	0.10	0.04		0.00	0.00	0.04	0.07		
Depreciation - Low ($/ac)	1.49	0.21	0.81	0.05	0.05	0.67	0.93	0.00	1.49	1.25	0.09	0.01		0.00	0.00	0.01	0.07		
Finance Costs - High Rate ($/h)	25	5	4	0	0	2	29	0	5	6.25	3.75	0.50		0	0	0	2		
Finance Costs - Low Rate ($/h)	8	2	1	0	0	1	10	0	3	3.13	1.88	0.25		0.00	0.00	0.16	0.20		
Finance Costs - High Rate ($/ac)	1.12	0.21	0.24	0.00	0.00	0.09	1.98	0.04	0.53	0.31	0.03	0.00		0.00	0.00	0.06	0.20		
Finance Costs - Low Rate ($/ac)	0.56	0.11	0.12	0.00	0.00	0.07	0.96	0.02	0.44	0.31	0.02	0.00							
Maintenance Cost - High Rate ($/ac)	0.68	0.23	1.11	0.13	0.13	0.23	1.00	1.25	1.00	0.75	0.17	0.09		0.20	0.60	2.00	0.90		
Maintenance Cost - Low Rate ($/ac)	0.33	0.13	0.50	0.07	0.07	0.13	1.00	1.00	0.83	0.50	0.05	0.05		0.20	0.60	1.67	0.90		
Labour Cost - High Rate ($/ac)	0.68	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.75	0.00	0.13		0.00	1.60	0.00	0.78		
Labour Cost - Low Rate ($/ac)	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	2.00	1.50	0.00	0.18		0.00	3.00	0.00	1.80		
Operating Costs - High Rate ($/h)	44.00	0.00	22.00	2.00	2.00	26.26	82.78	16.00	47.78	40.00	0.00	41.28		0.00	46.00	20.00	41.28		
Operating Costs - Low Rate ($/h)	28.00	0.00	0.00	0.00	0.00	26.26	41.39	8.00	26.26	20.70	0.00	20.70		0.00	38.70	10.00	20.70		
Operating Costs - High Rates ($/ac)	2.04	0.25	1.11	0.13	0.13	1.66	3.62	1.20	4.78	2.40	0.17	0.36		0.20	4.60	2.00	2.06		
Operating Costs - Low Rates ($/ac)	1.77	0.13	0.00	0.07	0.07	1.75	4.13	1.00	5.04	2.58	0.05	0.31		0.20	5.80	1.67	2.06		
Hauling & Operating Costs - High Rates ($/h)	101.31	21.31	46.34	3.40	3.40	59.39	288.84	12.09	70.69	88.75	42.69	48.78		2.00	46.60	29.75	55.59		
Hauling & Operating Cost - Low Rates ($/h)	65.04	6.74	12.68	0.90	0.90	37.70	116.35	8.04	47.69	46.39	14.39	21.69		1.00	39.70	13.00	28.40		
Hauling & Operating Costs - High Rates ($/ac)	5.07	0.68	2.07	0.20	0.20	2.65	16.28	1.91	7.69	4.04	0.37	0.61		0.20	4.60	2.97	2.80		
Hauling & Operating Cost - Low Rates ($/ac)	3.73	0.45	1.09	0.07	0.07	2.68	11.59	1.11	7.84	4.04	0.15	0.33		0.20	5.80	2.10	3.04		
Gross Value Grain Croc Based Upon Method ($)	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	450785	460.785	6130	6130	21697	21697	27827	478,613
Cost of Croc Production $	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324640	324.640	0	0	0	0	0	324,640
Value of Grain Loss - High Rate ($)	5919	3153	0	3946	3946	0	22539	5919	0	0	0	0	45423	0	0	0	0	0	45423
Value of Grain Loss - Low Rate ($)	987	526	0	395	395	0	4506	1973	0	0	0	0	5762	0	0	0	0	0	5762
Crop Value - High Rate at Operating Cost ($/ac)	110.38	216.95	101.46	114.07	114.07	216.95	41.69	51.02	69.07	52.37	64.07	64.45		3.43	4.02	6.73	6.67		
Crop Value - Low Rate at Operating Cost ($/ac)	116.07	220.39	102.66	117.52	117.52	221.31	42.69	53.05	64.45	54.45	64.45	64.45		3.43	3.43	11.73	11.73		
Crop Value - Operating & Ownership Cost - High Rates ($/ac)	103.38	214.01	99.03	113.99	113.99	215.08	39.79	50.79	47.69	53.01	64.49	64.44		3.43	4.02	6.76	6.69		
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)	103.38	218.04	101.33	117.45	117.45	218.78	41.39	52.99	48.05	53.01	64.49	64.52		3.43	3.43	8.07	7.99		

Summary

Ownership Costs												
Total Cost of ownership - High Rate ($/year)	56025	0	56025	56025	1050	57075	56025	0	56025	56025	7560	63585
Total Cost of ownership Low Rate ($/year)	31065	0	31065	31065	2940	34005	31065	0	31065	31065	2940	34005
Operating Parameters												
Variable Input Operating Costs												
Fuel Price ($/L)												
Operating Cost												
Total ($) - High Rate	3770	0	3770	3770	1260	5030	3770	0	3770	3770	1260	5030
Total ($) - Low Rate	2114	0	2114	2114	1260	3374	2114	0	2114	2114	1260	3374
Calculated Cost Rates												
Fuel Cost - High Rate ($/h)												
Fuel Cost - Low Rate ($/h)												
Fuel Cost - High Rate ($/ac)												
Fuel Cost - Low Rate ($/ac)												
Operating Costs - High Rate ($/h)												
Operating Costs - Low Rate ($/h)												
Operating Costs - High Rates ($/ac)												
Operating Costs - Low Rates ($/ac)												
Owning & Operating - High Rates ($/hr+)	7547	0	7547	7547	1260	8807	7547	0	7547	7547	1260	8807
Owning & Operating - Low Rates ($/hr+)	6427	0	6427	6427	1260	7687	6427	0	6427	6427	1260	7687
Owning & Operating Costs - High Rates ($/h)												
Owning & Operating Cost - Low Rates ($/h)												
Owning & Operating Costs - High Rates ($/ac)												
Owning & Operating Cost - Low Rates ($/ac)												
Crop Value												
Gross Value Grain Crop($)												
Cost of Crop Production ($)												
Crop Value - Production and High Loss($)	3402	27527	22334	3402	27527	22334	54985	27527	42857	54985	27527	72511
Crop Value - Production and Low Loss($)	25058	27527	54985	25058	27527	54985	52584	27527	48857	20684	27527	48211
Crop Value - High Rate of Operating Costs ($)	13063	27527	11436	16063	1260	29179	74197	27527	102724	74197	12264	86461
Crop Value - Low Rate of Operating Cost ($)	11280	27527	17247	11280	1260	12414	68438	27527	120524	68438	6948	75386
Crop Value - High Rate of Operating Cost ($/ac)												
Crop Value - Low Rate of Operating Cost ($/ac)												
Crop Value - Op. & Own Cost - High Rates($)	43438	27527	98812	43438	3991	74698	23404	27527	81351	43954	3991	47294
Crop Value - Op. & Own Cost - Low Rates ($)	25983	27527	11742	25983	4040	30023	19187	27527	98461	19187	1043	20230
Crop Value - Operating & Ownership Cost - High Rates ($/ac)												
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)												

Summary

To transfer summary data ; **Farm Plan 1 - System 1** Press **"CONTROL & SHIFT & A"** **Farm Plan 1 - System 2** - Press **"CONTROL & SHIFT & B"**
Farm plan 2 - System 1 Press **"CONTROL & SHIFT & C"** **Farm Plan 2 -System 2** - Press **"CONTROL & SHIFT & D"**

Option	FP1-SYS1 Summary Grain Only	FP1-SYS1 Summary MOG	FP1-SYS1 Summary Grain & MOG	FP1 - SYS 2 Summary Grain Only	FP1 - SYS 2 Summary MOG Only	FP1 - SYS 2 Summary Grain & MOG	FP2 -SYS 1 Summary Grain Only	FP2 -SYS 1 Summary MOG Only	FP2 -SYS 1 Summary Grain & MOG	FP2-SYS2 Summary Grain Only	FP2-SYS2 Summary MOG Only	FP2-SYS2 Summary Grain & MOG
Machine Name												
Operating Parameters												
Machine Value ($)												
Portion of Investment Financed (%)												
Financing Charges - High (%)												
Financing Charges - Low (%)												
Depreciation Rate - High (%)												
Depreciation Rate - Low (%)												
Financing Cost - High Rate ($/year)	10270	0	10270	10270	1500	11770	10270	0	10270	10270	1500	11770
Financing Cost - Low Rate ($/year)	5135	0	5135	5135	750	5885	5135	0	5135	5135	750	5885
Depreciation - High Rate ($/year)	45780	0	45780	45780	5500	51280	45780	0	45780	45780	5500	51280
Depreciation - Low Rate ($/year)	25920	0	25920	25920	2750	28670	25920	0	25920	25920	2750	28670
Total Crop Area for Farm (ac)	2300.00	1880.00	2300.00	2300.00	1880.00	2300.00	2300.00	1880.00	2300.00	2300.00	1880.00	2300.00
Area of Crop Windrowed												
Area of Crop Direct Cut												
Area of Crop Stripped												
Use - Area of crop per year (ac)	1137	0	1137	1137	616	1753	728	0	728	728	616	1344
Operating Time - Higer Work Rate (h)	1928	0	1928	1928	1169	3097	1278	0	1278	1278	1169	2447
Operating Time - Lower Work Rate (h)												
Hours of Use for Season												
Fuel Use Rate- High (L/h)												
Fuel Use Rate - Low (L/h)												
Loss - High (% of yield)												
Loss - Low (% of yield)												
Work Rate Rate - Higher (ac/h)												
Work Rate - Lower (ac/h)												
Operator Labour Rate ($/h)												
Maintenance Cost Estimate - High Rate($/h)												
Maintenance Cost Estimate - Low Rate ($/h)												
Cost of fuel - High Rate ($)	12436	0	12436	12436	5813	18249	7419	0	7419	7419	5813	13232
Cost of fuel - Low Rate ($)	13279	0	13279	13279	6113	19393	7655	0	7655	7655	6113	13768
Cost of Labour - High Rate($)	8893	0	8893	8893	3923	12816	5455	0	5455	5455	3923	9377
Cost of Labour - Low Rate ($)	14653	0	14653	14653	7845	22498	9133	0	9133	9133	7845	16978
Maintenance - High Rate ($)	12441	0	12441	12441	5808	18249	7914	0	7914	7914	5808	13722
Maintenance - Low Rate ($)	9185	0	9185	9185	5022	14208	5461	0	5461	5461	5022	10484
Depreciation - High ($/h)												
Depreciation - Low ($/h)												
Depreciation - High ($/ac)												
Depreciation - Low ($/ac)												
Finance Costs - High Rate ($/h)												
Finance Costs - Low Rate ($/h)												
Finance Costs - High Rate ($/ac)												
Finance Costs - Low Rate ($/ac)												
Maintenance Cost - High Rate ($/ac)												
Maintenance Cost - Low Rate ($/ac)												
Labour Cost - High Rate ($/ac)												
Labour Cost - Low Rate ($/ac)												
Operating Costs - High Rate ($/h)												
Operating Costs - Low Rate ($/h)												
Operating Costs - High Rates ($/ac)												
Operating Costs - Low Rates ($/ac)												
Owning & Operating Costs - High Rate ($/h)												
Owning & Operating Cost - Low Rate ($/h)												
Owning & Operating Costs - High Rate ($/ac)												
Owning & Operating Cost - Low Rates ($/ac)												
Gross Value Grain Crop($)	360550	27827	388377	360550	27827	388377	450785	27827	478612	450785	27827	478612
Cost of Crop Production $	324640	0	324640	324640		324640	324640	0	324640	324640	0	324640
Value of Grain Loss (Method) - High Rate ($)	41403	0	41403	41403		41403	31160	0	31160	31160	0	31160
Value of Grain Loss (Method) - Low Rate ($)	9052	0	9052	9052		9052	5461	0	5461	5461	0	5461
Crop Value - High Rate of Operating Cost ($/ac)												
Crop Value - Low Rate of Operating Cost ($/ac)												
Crop Value - Operating & Ownership Cost - High Rate ($/ac)												
Crop Value - Operating & Ownership Cost - Low Rates ($/ac)												

Appendix III

Report on 2006 Stripper Header Field Trials

Project No. 5006H
Revised: February 28, 2007
Date: February 9, 2007
Humboldt, Saskatchewan

Research Report

Final Report

2006 Stripper Header Field Trials

for:

Agriculture and Agri-Food Canada

February 9, 2007
Revised: February 28, 2007
Humboldt, Saskatchewan
5006H

Research Report

Final Report

2006 Stripper Header Field Trials

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1. Executive Summary

The key objective of this project was to determine if the straw quantity and quality would be significantly different when comparing the different harvesting methods -- direct cutting and stripping. This was to be determined by the straw processors who have special requirements that suit their process.

Of the planned field trials in wheat and flax, only the wheat field trial provided comparative results. Even these results were far from an accurate comparison between the two harvesting methods.

The observation in the field was that there was a noticeable difference in the straw left for recovery. The straw from direct cutting went through the combine. The straw from the conventional combine was slightly broken but quite clean. The straw from the rotary combine was broken into smaller pieces and had chaff intermixed. Both straws were easily baled by the large square baler.

The straw left behind the stripper had not gone through the combine, so it was unbroken. All of the leaves and some of the smaller top stems were gone. This straw did not make well-formed windrows as it did not knit together. As such, it was vulnerable to the wind that scattered the windrows easily.

The flax fields that were chosen for testing were so highly variable that it was impossible to get comparative measurements. The only results available were to develop a subjective assessment on how well the stripper header worked with the two different combines and some of the operating challenges that came with undulating terrain.

The challenge of comparing all aspects of machine behavior is that considerable experimentation is first required to fully understand the interaction between machine settings and particular crop conditions. As well, the operators have to be very conscious of operating requirements and limitations. The other key factor is that accurate measurements have to be made. This means precision and repetition. In this case, many factors have to be controlled, documented, and the results measured.

The limited results, although offering some insight into performance characteristics, provided ample support for more scientific testing if the opportunity arises.

2. Project Description

Stripper header technology has been available since the mid 1980s but has had limited uptake in general grain farming in western Canada. A few producers have used it with some success harvesting malting barley. But, it has mostly been ignored as an alternative to direct cutting because it has been regarded as expensive, heavy, and not an "all-crop" header. As well, it is generally regarded as having higher gathering losses. These factors have been deemed to outweigh possible benefits of higher productivity.

Recently, other considerations have arisen. Industries using crop residue, primarily straw, have become concerned about the quantity and quality of straw that is available after harvesting. Some of the reasons for the decrease in straw include development of new varieties that minimize the amount of straw grown, since straw tends to have little value, requires more nutrients, and limits combine capacity. At the same time, combine development has shifted heavily to rotary technology in order to achieve higher capacity. Rotary combines tend to cause mechanical damage to straw, converting some straw into chaff. At the same time, a higher percentage of crops are being direct cut, which allows operators to cut higher and maximize combine capacity. The net result is less straw that is shorter and more damaged.

One possible solution is to use a stripper header for harvesting, especially wheat and flax. The straw would not go through the combine and, therefore, be less damaged, and it would allow lower cutting to recover more of the remaining straw.

This project was designed as a preliminary step to determine if, under real field conditions, the stripper header would be able to provide more and better straw in wheat and flax. At the same time, as many measurements and observations as practical would be made to provide insight into the practical application of stripper technology as an alternative to traditional gathering systems.

3. Results and Conclusions

3.1 Equipment

A Shelbourne Reynolds 28 ft stripper header was supplied by the Saskatchewan Flax Council and delivered to the test sites by Agri-Food Canada. It was used at the wheat test site and the two flax test sites.

The Kamsack co-operator supplied a John Deere 9860 STS combine and a John Deere 9610 combine along with a 30 ft John Deere 930 rigid header. PAMI provided a grain truck with load measuring scales integrated into the box. As well, PAMI provided GPS for plot measurements and a service truck and fuel caddy with pump and meter. Miscellaneous equipment was also supplied for collecting and measuring field grain loss.

The co-operator provided an auger for unloading the PAMI grain truck into a grain transport truck. A windrower was supplied for cutting the stripped straw. The Straw Board plant provided a large square baler for baling the straw and loading equipment for handling the bales for delivery to the plant. A grain cart with scales was rented from a local dealer to assist in moving grain more quickly.

At Redvers, for testing in flax, the co-operator supplied a John Deere 9650 combine and a John Deere 9600 combine along with a Honey Bee 36 ft draper header and a John Deere 930 30 ft rigid header.

At Oxbow, the co-operator supplied a John Deere 9860 combine. His header was not used.

3.2 Crops and Conditions

The wheat field selected near Kamsack was about 110 ha (275 ac). The field shape and corresponding segments harvested by the various equipment combinations is shown in **Appendix I**. The crop was generally standing well except for a few lodged patches on the east side. The crop height was about 1 m and yielded about 4.78 t/ha (66 bu/ac). The yield was higher on the south end and dropped off progressing north. The crop was dry, but in some areas, the straw was still fairly high in moisture and had a green tinge. Though the crop was standing well, there was a considerable amount of heads that had sunk down into the crop. This crop was representative of a heavy wheat crop.

The flax crops in Redvers and Oxbow were far from being ideal crops. The terrain was highly variable in the Redvers field. The extent of the variability is easily seen in the GPS map in **Appendix I**. The yield was low, and the crop was generally quite short. The

stand varied greatly with the variability in the terrain. A portion of the field had severe hail damage, which faded across the field on a diagonal. As well, some of the field was double seeded as a part of a different trial.

The field at Oxbow was not as undulating as the field at Redvers but still had water runs, weed infestation, and the yield was low and variable over the field.

Generally, the flax fields were only suitable for demonstrating operating characteristics in challenging conditions.

3.3 Procedure

The Shelbourne-Reynolds header was fitted to each combine just prior to running the comparative trials. Little opportunity was available for experimentation in the wheat. On most trials, a co-operator was allowed to run the combine, which added uncertainty to the validity of some of the results. Operating time was monitored, and the area harvested was measured. At the same time, an estimate of fuel use was determined by refilling the combine's fuel tank to approximately the same level. The grain harvested was unloaded into the PAMI grain truck, and the mass was recorded. The grain was then transferred into a transport truck. Grain loss measurements were randomly made for each machine at various spots across the test plots. The ground samples were made by collecting the free grain and heads that were deposited in a 1 m square. The combine losses were based upon the total material discharged from the combine. This material was collected from a stationary pan, which had been deployed from under the combine.

In the wheat crop, it was hoped that four similar-sized plots could be harvested. Due to complications, not all of these plots were of the same size.

The straw from the combines using direct cut headers was dropped in a windrow behind the combine. The straw left behind the stripper had to be windrowed before baling. The straw chopper and chaff spreader were operated when stripping to prevent problems when cutting with the windrower in subsequent operations.

The flax crops were so uneven that it was not possible to run any comparative trials. At best, the sites simply provided an opportunity to subjectively assess the interaction between the combines and the different headers and to learn more about the operation of the stripper header. A couple of measurements were made, but there were many variables that were not defined, so the results are only for indication purposes.

3.4 Test Results

The test results for the wheat trials are shown in **Tables 1** and **2**.

Some of the possible differences indicated by the tests suggest that on the conventional combine (John Deere 9610) the performance was very similar in terms of grain harvested per hour and fuel use per hour or unit of grain. The main difference was that the stripper header combination had to operate at a higher ground speed in order to produce the same results. This was not just to compensate for difference in header width but also for decreasing yield. The area covered per hour was 32% higher. Under identical conditions, this may have translated into a somewhat higher grain harvest rate.

The rotary header combination's results were quite similar when it came to grain harvested per hour and area covered per hour. The main difference seemed to be a reduction in fuel use per hour, area, and grain mass. Based upon grain mass, this appeared to be about a 10% decrease in fuel use per unit of grain. There was nearly a 17% decrease in fuel per unit area harvested.

In the flax trials, limited data was obtained, but the indication was that the stripper header provided higher productivity than either the rigid header or the draper header (**Tables 3** and **4**).

3.5 Impact on Industrial Use

Complete information is not yet available on the difference in the resulting straw characteristics from the stripper harvest crops compared to that harvested from the direct cut headers. Some preliminary data regarding straw retrieval from baling gives some indication of the recovery differences between headers and combine combinations. **Table 5** shows results from the Kamsack trials where the straw was baled (or windrowed and baled) then weighed by Above Board. Results are not yet available on flax.

Data from Plot 1 must be ignored due to baling at too high a moisture content. The remaining results indicate the impact of the combine/header combination upon straw recovery.

It must be noted that:

- The chaff from the JD 9610 did not get mixed into any straw being dropped in a windrow behind the combine.
- For the JD 9860, the chaff was admixed with the straw that dropped into the windrow behind the combine.

- When using the stripper header, both combines chopped and/or spread all MOG that passed through the combine and was unlikely to have been captured in subsequent cutting and baling operations.
- The measured grain yield varied across the field, decreasing as the plot numbers increased. MOG yields were not established so it is unknown if there was also a significant shift in the MOG/Grain ratio.

Assuming that the MOG/G ratio remained reasonably similar for the test, the results then suggest that based on the difference between the MOG/G ratios approximately 20% less MOG was recovered after combining when using the stripper header versus the rigid header.

For the conventional combine, the results suggest that there would be at least 20% more straw available when using a rigid header cutting at a typical height than from the straw recovered from windrowing behind the stripper header. The rotary combine had the highest MOG/G ratio suggesting that it provided the highest amount of straw. However, considering that a portion of the MOG recovered from the combine's windrow would be comprised of chaff, the actual straw would in all likelihood be similar to that recovered from cutting and baling the stripped straw.

These are only preliminary results based upon the field recovery numbers provided by Above Board. A key part of the information still rests with the suitability of the straw from the different combine/header combinations. The encouraging results reflect the same trend in behaviour regardless of which combine the stripper header was installed on.

Table 1. Wheat Data – Metric.

KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss -Total - Combine	
				August		ha	h	kg	T	L	t/ha	L/h	L/ha	L/t	t/h	ha/h	km/h	kg/ha	kg/ha
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	26.4	8.3	131,447	131.4	370	5.0	44.6	14.0	2.8	15.8	3.2	3.6	< 220	< 150
JD 9610 W	SR 28 S	T.B.	5	30	wheat	19.3	5.0	82,542	82.5	237	4.3	47.4	12.3	2.9	16.5	3.9	4.7	220 - 520	<150
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	28.2	6.4	144,340	144.3	466	5.1	72.8	16.5	3.2	22.6	4.4	5.0	300 - 370	<75
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5	65,681	65.7		4.9				18.8	3.9	4.7		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0	49,420	49.4		4.4				24.7	5.6	6.8		
JD 9860 STS	SR 28 S	Farmer	3ab	29-30	wheat	24.6	5.5	115,101	115.1	337	4.7	61.3	13.7	2.9	20.9	4.5	5.4	370 - 520	75
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.6	53,911	53.9	204	4.5	78.5	17.2	3.8	20.7	4.6	5.2		

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

Table 2. Wheat Data – Imperial.

KAMSACK TRIALS in SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Total - Combine Loss	
						acres	h	pounds	bushels	Litres	bu/ac	L/h	L/ac	bu/L	bu/h	ac/h	mph	bu/ac	bu/ac
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	65.3	8.3	289787	4535	370	69	44.6	5.7	12.26	546	7.9	2.2	< 1.5	< 1.0
JD 9610 W	SR 28 S	T.B.	5	30	wheat	47.8	5	181970	2824	237	59	47.4	5.0	11.92	565	9.6	2.9	1.5 - 3.5	<1.0
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	69.8	6.4	318210	4980	466	71	72.8	6.7	10.69	778	10.9	3.1	2 -2.5	<0.5
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	33.3	3.5	144800	2266		68				647	9.5	2.9		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	27.5	2	108950	1705		62				853	13.8	4.2		
JD 9860 STS	SR 28 S	Farmer	3ab	29-30	wheat	60.8	5.5	253750	3971	337	65	61.3	5.5	11.78	722	11.1	3.4	2.5 - 3.5	0.5
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	29.3	2.6	118852	1860	204	63	78.5	7.0	9.117	715	11.3	3.2		

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

Table 3. Flax Data – Metric.

REDVERS TRIALS IN FLAX AUGUST - SEPTEMBER 2006 - Metric

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss -Total - Combine	
				Aug-Sep		ha	h	kg	T	L	t/ha	L/h	L/ha	L/t	t/h	ha/h	km/h	kg/ha	kg/ha
JD 9600 W	JD 930 R	Farmer	SS	31- 1	Flax	15.7	3.6	20,830	20.8	XX	1.3	XX	XX	XX	5.7	4.3	7.0	XX	XX
JD 9610 W	SR 28 S	Farmer	SS	31- 1	Flax	3.7	0.5	5,200	5.2	XX	1.4	XX	XX	XX	9.6	6.8	11.0	XX	XX
JD 9860 STS	HoneyBee	PAMI	SS	30-1	Flax	4.5	0.8	3,945	3.9	XX	0.9	XX	XX	XX	4.8	5.5	8.9	XX	XX
JD 9860 STS	SR 28 S	PAMI	SS	30-1	Flax	16.8	2.0	22,486	22.5	XX	1.3	XX	XX	XX	11.4	8.5	13.9	XX	XX
JD 9860 STS	HoneyBee	PAMI	DS	30-31	Flax	1.6	0.3	1,655	1.7	XX	1.0	XX	XX	XX	5.7	5.5	8.9	XX	XX

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

Table 4. Flax Data – Imperial.

REDVERS TRIALS IN FLAX AUGUST - SEPTEMBER 2006 - Imperial

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss -Total - Combine	
				Aug-Sep		ac	h	lb	bu	gal	bu/ac	gal/h	gal/ac	bu/gal	bu/h	ha/h	km/h	bu/ac	bu/ac
JD 9600 W	JD 930 R	Farmer	SS	31- 1	Flax	38.8	3.6	45,826	818.3	XX	21.1	XX	XX	XX	227.3	10.8	7.0	XX	XX
JD 9610 W	SR 28 S	Farmer	SS	31- 1	Flax	9.1	0.5	11,440	204.3	XX	22.5	XX	XX	XX	408.6	18.2	11.0	XX	XX
JD 9860 STS	HoneyBee	PAMI	SS	30-1	Flax	11.1	0.8	8,679	155.0	XX	13.9	XX	XX	XX	193.7	13.9	8.9	XX	XX
JD 9860 STS	SR 28 S	PAMI	SS	30-1	Flax	41.5	2.0	49,469	883.4	XX	21.3	XX	XX	XX	441.7	20.7	13.9	XX	XX
JD 9860 STS	HoneyBee	PAMI	DS	30-31	Flax	3.9	0.3	3,641	65.0	XX	16.5	XX	XX	XX	216.7	13.1	8.9	XX	XX

R = Rigid Auger Header, SR = Stripper Header, SS = Single Seeded, DS = Double Seeded W = Walker, STS = Rotary

Table 5. Straw Recovery Results From Kamsack Tests.

KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006															
Combine	Header	Operator	Plot #	Date August	Crop	Area ha	Time h	Fuel L	Grain Harvested kg	Grain Harvested t	MOG Baled kg	MOG Baled t	GrainYield t/ha	MOG Yield t/ha	MOG/G Ratio
JD 9610 W	JD 930 R	T. B.	**2**	28-29	wheat	26.4	8.3	370	131,447	131.4	79586	79.6	5.0	3.0	0.605
JD 9610 W	SR 28 S	T.B.	**5**	30	wheat	19.3	5.0	237	82,542	82.5	40010	40.0	4.3	2.1	0.485
JD 9860 STS	JD 930 R	Farmer	**1**	28 - 29	wheat	28.2	6.4	466	144,340	144.3	42638	42.6	5.1	1.5	0.295
JD 9860 STS	SR 28 S	Farmer	**3a**	29	wheat	13.5	3.5		65,681	65.7			4.9		
JD 9860 STS	SR 28 S	Farmer	**3b**	30	wheat	11.1	2.0		49,420	49.4			4.4		
JD 9860 STS	SR 28 S	Farmer	**3ab**	29-30	wheat	24.6	5.5	337	115,101	115.1	58670	58.7	4.7	2.4	0.510
JD 9860 STS	JD 930 R	Farmer	**4**	30	wheat	11.9	2.6	204	53,911	53.9	34110	34.1	4.5	2.9	0.633
R = Rigid Auger Header, S = Stripper Header					W = Walker, STS = Rotary										

4. Conclusions and Recommendations

The key data that will determine the usefulness of these trials lies with the impact on industrial use of the straw from the stripper header harvested crop as compared to straw retrieved from typical harvesting operations. If there are favourable results, then the need for much better data is justified.

In order to get useful data, the test procedure must be managed closely so that all aspects are controlled. A proper setup of the equipment and plots, detailed procedures, the use of proper equipment for accurate measurement, repetition of tests, and ensuring adequate training and machinery maintenance are all required.

5. Project Photos

Figures 1 to **14** illustrate the machinery and crop.



Figure 1. Shelbourne Reynolds 28 ft stripper header.

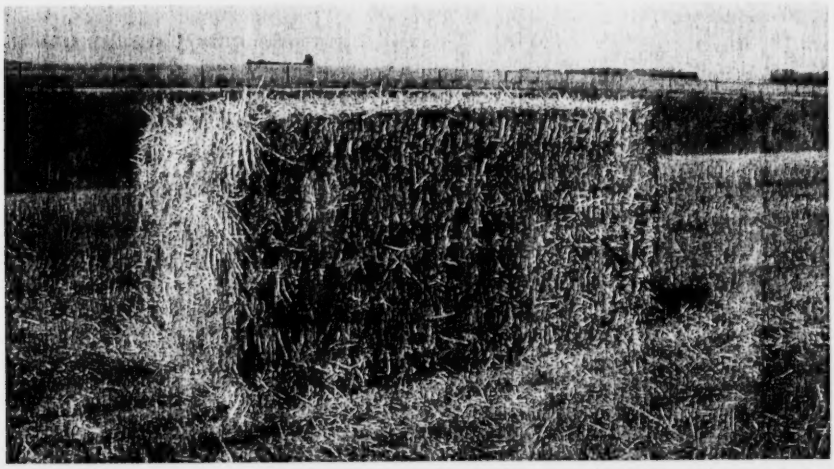


Figure 2. Large square bales made from dropped wheat straw near Kamsack (direct cut).



Figure 3. John Deere 9860 STS combine with stripper header in wheat near Kamsack.

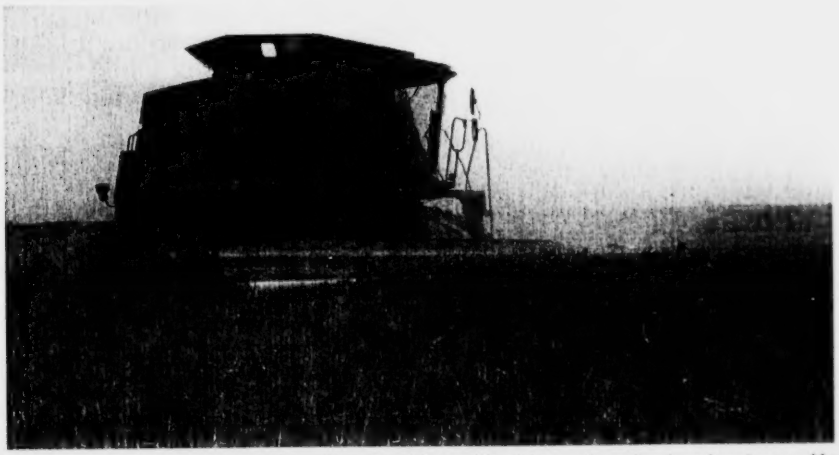


Figure 4. John Deere 9610 walker combine with stripper header in wheat near Kamsack.

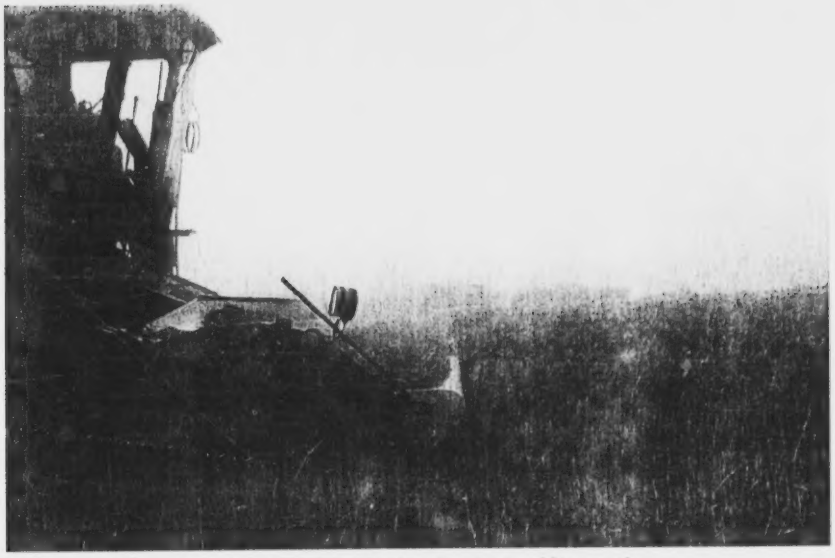


Figure 5. Side view of stripper header in wheat near Kamsack.



Figure 6. Close photo of stripper header in wheat near Kamsack.



Figure 7. Picture shows standing wheat on the left and stripped wheat on the right.



Figure 8. John Deere 9610 walker combine with 930 rigid direct cut header in wheat near Kamsack.



Figure 9. Dropped straw from 9860 STS with 960 rigid direct cut header in wheat near Kamsack.

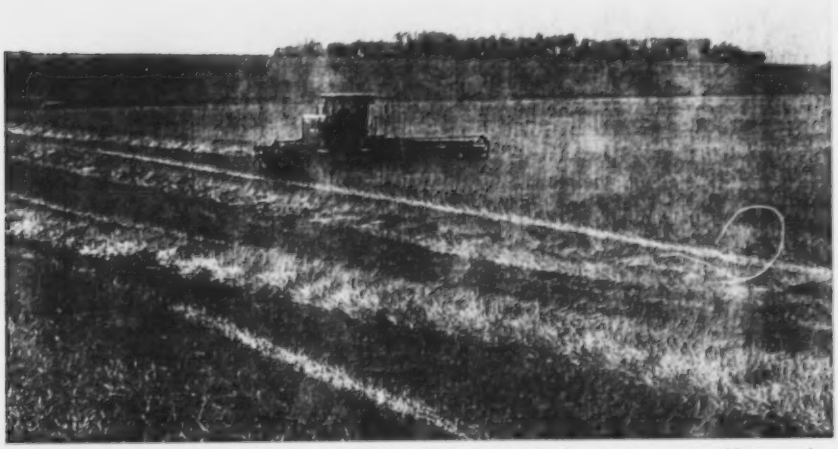


Figure 10. Case IH windrower cutting down stripped wheat straw near Kamsack.

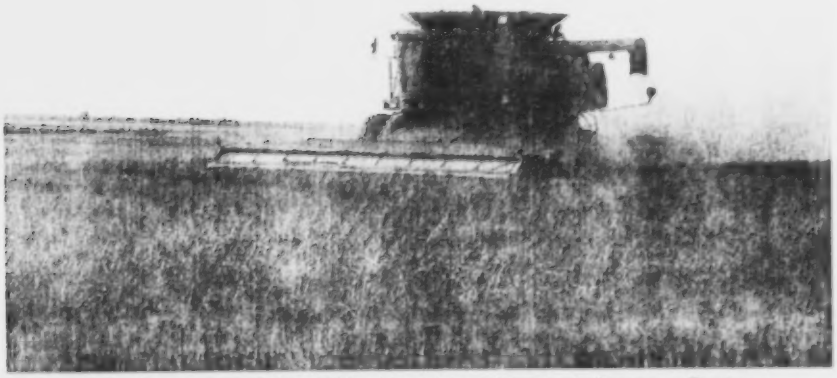


Figure 11. John Deere 9650 STS with stripper header in flax near Redvers.

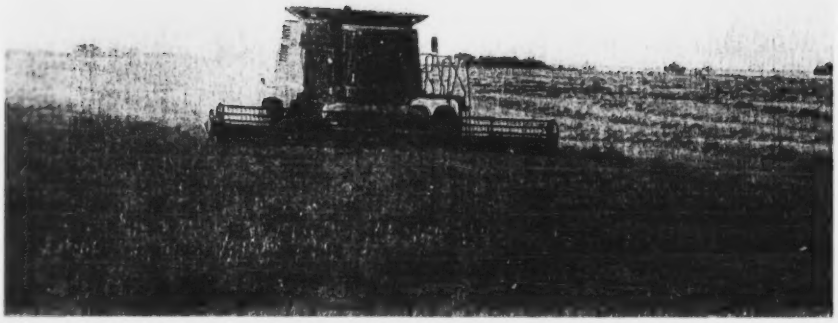


Figure 12. John Deere 9600 walker combine with 930 rigid direct cut header in flax near Redvers.



Figure 13. Dropped straw from 9650 STS with 36 ft draper.

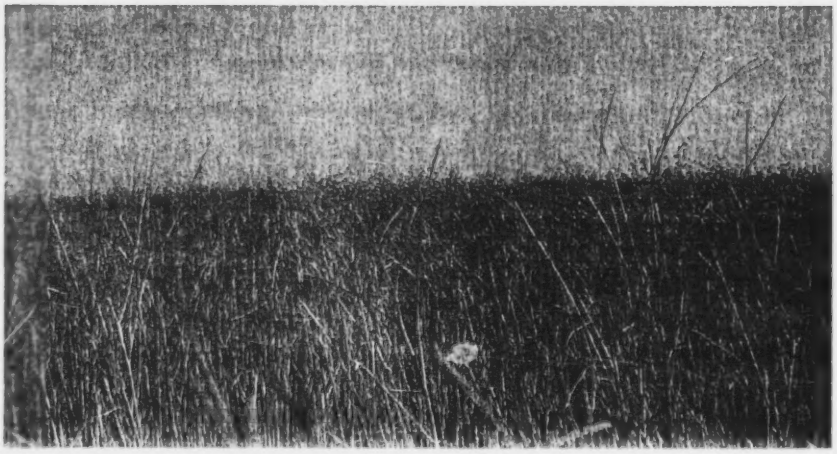
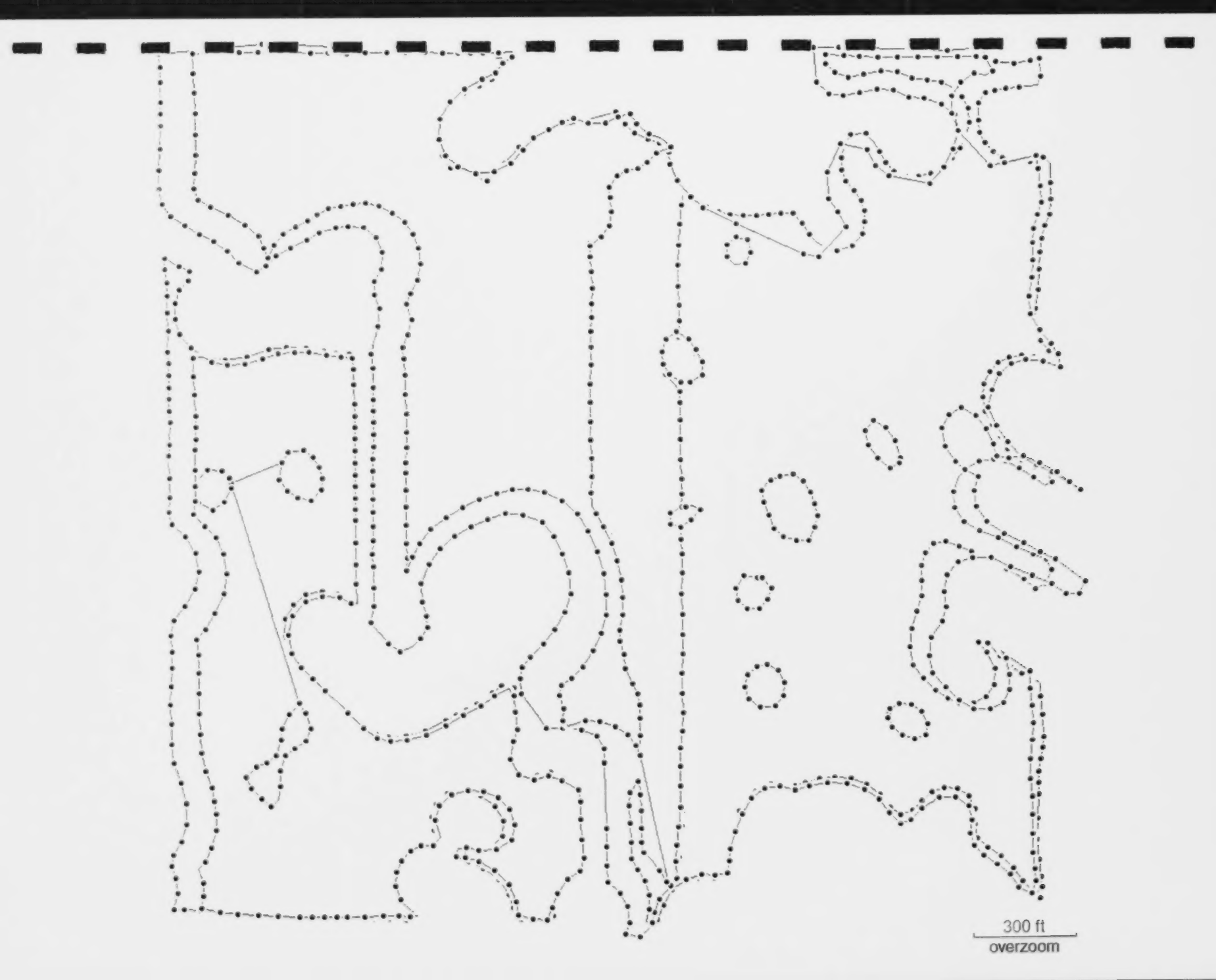


Figure 14. Close photo of stripped flax near Oxbow.

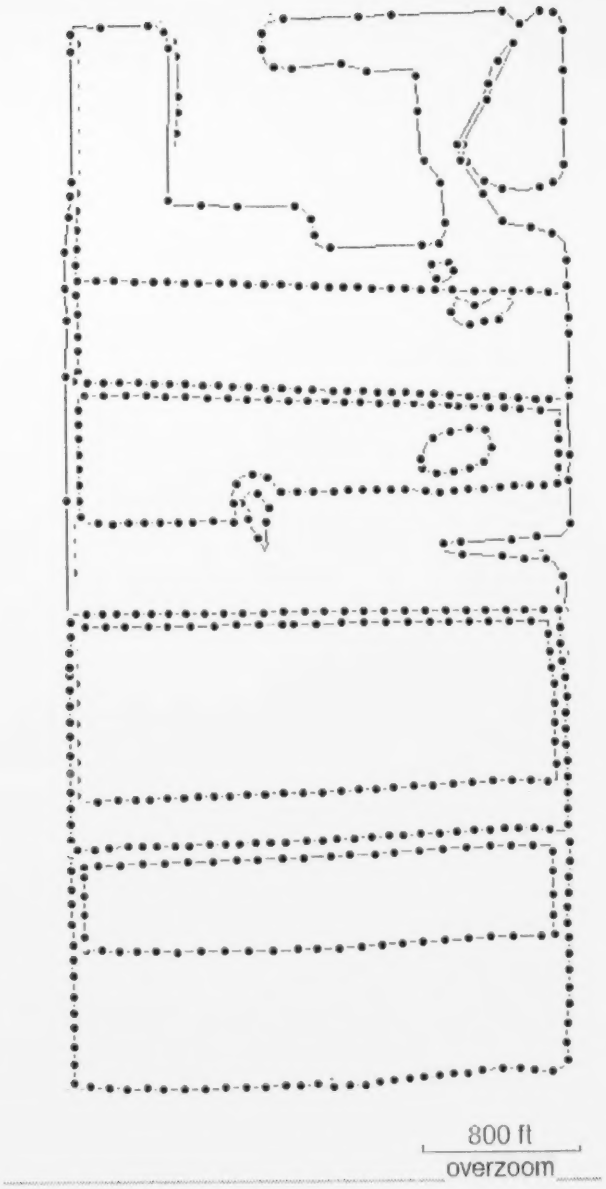
Appendix I

GPS Map of Redvers Field


300 ft
overzoom

Appendix II

GPS Map of Kamsack Field


800 ft
overzoom

Appendix III

GPS Map of Oxbow Field


800 ft
overzoom

Appendix IV

Data From Above Board on MOG Recovery from Kamsack Test Site

Load #	Date Received	Contract Number	Producer Name	Field ID #	Trucker ID #	Scale Ticket #	Quantity of Bales	Cumulative Bales	Scaled Tonnes	Moisture %	Average Bale Moist %	Average Bale Weight (lb)
Rejected Bales												
1	08/29/06	1	Walker	1	G1	1190	30	30	18.950	24%	**24%**	
2	08/29/06	1	Walker	1	G1	**1191**	30	60	23.688	30%	**27.0%**	
3	08/30/06	1	Walker	2	G1	1192	1	61	0.567	35%	**27.1%**	
			Total Rejected Bales				61		42.6375			**1,540.5418**
Accepted Bales												
3	08/30/06	1	Walker	2	G1	1192	30	90	16.215	10%	**10.0%**	1,191.2620
4	08/30/06	1	Walker	2	G1	1193	29	119	17.004	11%	**10.2%**	1,292.2787
5	08/30/06	1	Walker	2	G1	1194	30	149	17.590	10%	**10.2%**	1,292.2787
6	08/30/06	1	Walker	2	G1	1195	30	179	17.590	10%	**10.2%**	1,292.2787
7	08/31/06	1	Walker	2	G1	1196	18	197	10.620	10%	**10.1%**	1,300.3600
8	09/05/06	1	Walker	3	G1	1197	30	227	17.590	13%	**10.5%**	1,292.2787
9	09/05/06	1	Walker	3	G1	1198	30	257	17.590	11%	**10.5%**	1,292.2787
10	09/05/06	1	Walker	3	G1	1199	30	287	17.590	10%	**10.4%**	1,292.2787
11	09/05/06	1	Walker	3	G1	1200	10	297	5.900	10%	**10.4%**	1,300.3600
12	09/05/06	1	Walker	5	G1	1200	20	317	11.800	10%	**10.4%**	1,300.3600
13	09/06/06	1	Walker	5	G1	1201	30	347	17.590	10%	**10.3%**	1,292.2787
14	09/06/06	1	Walker	5	G1	1202	18	365	10.620	10%	**10.3%**	1,300.3600
15	09/06/06	1	Walker	4	G1	1202	12	377	7.080	10%	**10.3%**	1,300.3600
16	09/06/06	1	Walker	4	G1	1203	30	407	17.590	10%	**10.3%**	1,292.2787
17	09/06/06	1	Walker	4	G1	1204	16	423	9.440	10%	**10.3%**	1,300.3600
			Total Accepted bales				**363**		**211.8086667**	**Average weight**		**1,286.0229**

Total bales	424	254.4461667
Bales wrong moisture	149	
	275	

1191 Truckload returned to field

Incorrect cost estimates

	$/tonne	tonnes	Value
Value of baling	$ 24.00	211.8087	$ 5,083.41
Value of straw revised	$ 8.00	211.8087	$ 1,694.47

149

Note the extras for this trial run

	/bale		Value
$2 more/bale	$ 8.00	363	$2,904.00
$2.5 for stacking	$ 2.50	363	$907.50
Equipment relocation			$300.00
Sharp's			
			$4,111.50

Appendix IV

2006 Harvest System Workshop Presentation

Whole Crop Utilization Workshop





Canada

Three Groups of Stakeholders

- Producers
- Industry
- Public

Producers

- Bad Situation
  - -73 Million this year
  - -205 Million next year
- Focus $
  - Make most of all crops
  - Machinery and techniques
  - More profitable crops
- Change
  - Sustainable
  - Predictable
  - Support

Industry

- Markets
  - Real and sustainable
  - Growth potential
  - Strategic advantage
- Raw Material
  - Has real value
  - Can be optimized – in and out
  - Not dependant on subsidy
- R & D
  - Process
  - Machinery
  - Plants

Public

- Greener society
  - Wise use of resources
  - Less pollution
  - Benefit to Society – general
- Sustainable/Credible
  - Too many "flash in the pan"
  - Supporting R & D
- Cost Effective
  - Co-operation/Co-ordination
  - Builds a new future
  - Has positive financial impact

Our Objectives

- Understand
- Plan
- Co-operate
- Deliver

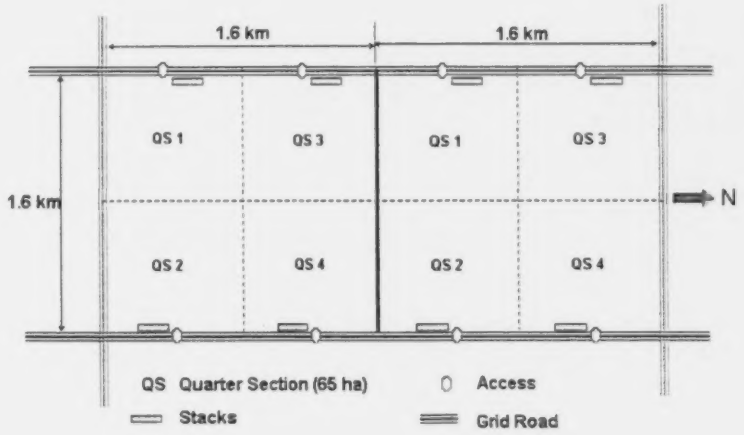
Integrated Biomass Supply Engineering

Shahab Sokhansanj
Oak Ridge national Laboratory
University of British Columbia
March 9, 2006

IBSAL Model - Description

- The Integrated Biomass Supply Analysis and Logistics (IBSAL) model has been developed to simulate physical flow of biomass from collection to biorefinery.
- IBSAL integrates technology and management information system for collecting, storing, processing, and transporting biomass.
- IBSAL model functions similar to ASPEN model used for analysis of process engineering in chemical industry.
- IBSAL model is made up of modules each representing a biomass handling process.

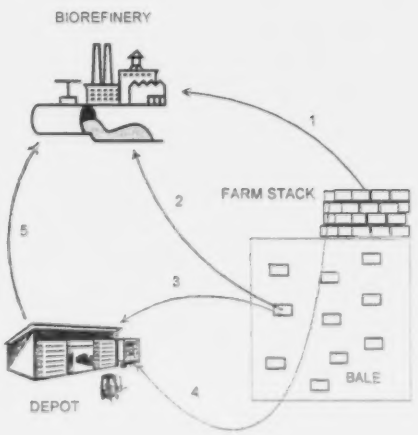
Logistics of collection

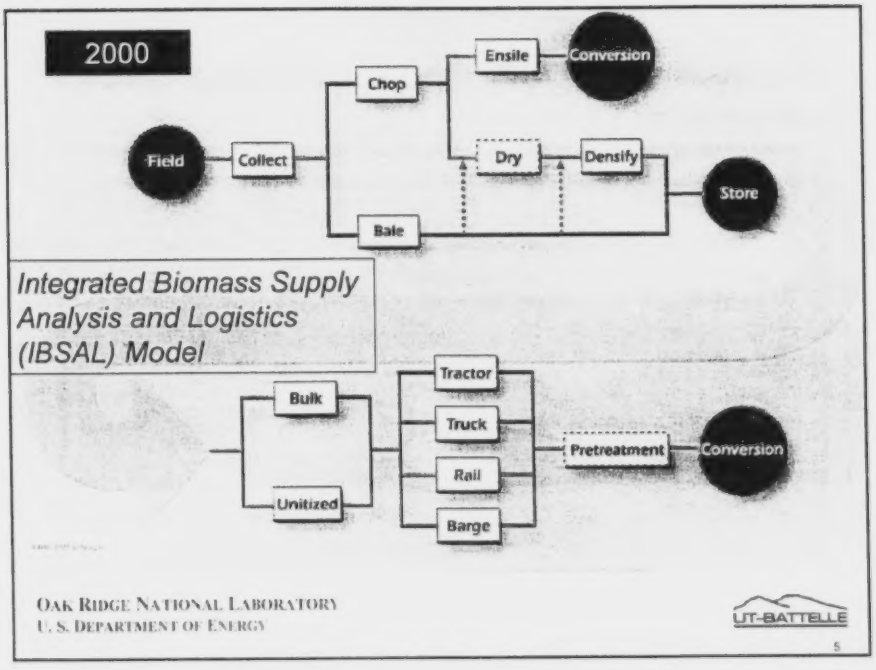


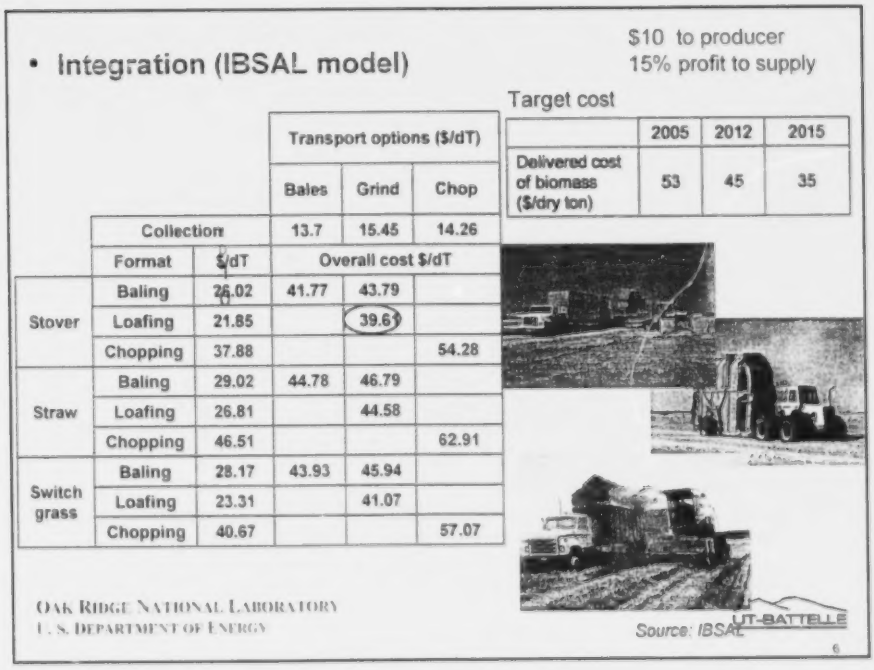
Storage & transport logistics

Determining factors:
- Economics
- Seasonality
- Agronomic practices
- Developmental stage

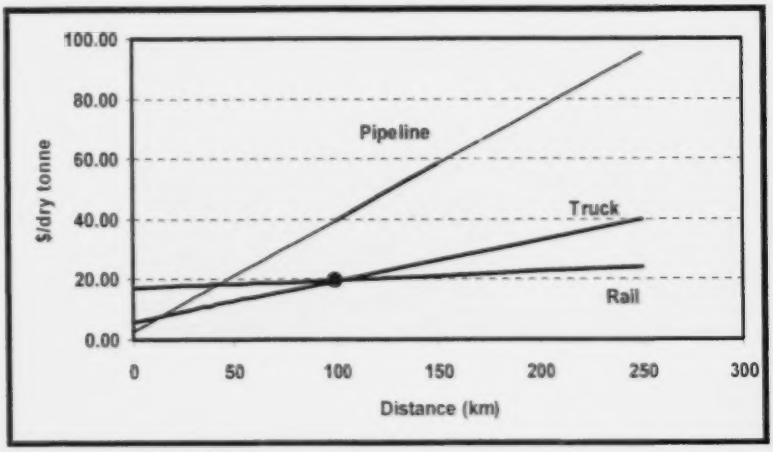
Multi modal transport systems
- Truck
- Train
- Waterways
- Pipeline



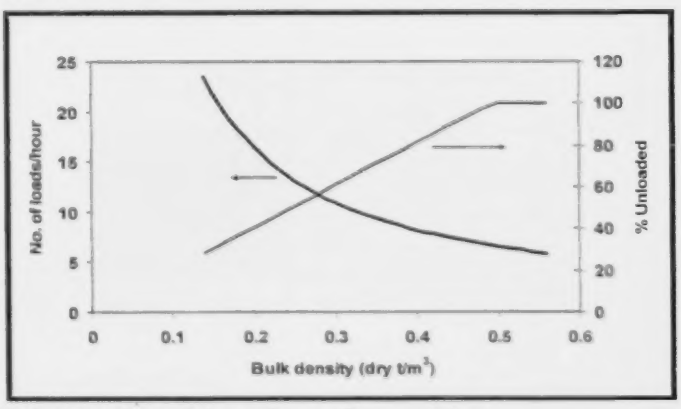

2000
Field
Collect
Chop
Bale
Ensile
Conversion
Dry
Densify
Store
Integrated Biomass Supply Analysis and Logistics (IBSAL) Model
Bulk
Unitized
Tractor
Truck
Rail
Barge
Pretreatment
Conversion
OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY
UT-BATTELLE
5


• Integration (IBSAL model)
$10 to producer
15% profit to supply
Target cost
2005 2012 2015
Delivered cost of biomass ($/dry ton) 53 45 35
Transport options ($/dT)
Bales Grind Chop
Collection 13.7 15.45 14.26
Format $/dT Overall cost $/dT
Stover Baling 26.02 41.77 43.79
Loafing 21.85 39.61
Chopping 37.88 54.28
Straw Baling 29.02 44.78 46.79
Loafing 26.81 44.58
Chopping 46.51 62.91
Switch grass Baling 28.17 43.93 45.94
Loafing 23.31 41.07
Chopping 40.67 57.07
OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY
UT-BATTELLE
Source: IBSAL
6

Transport cost is the highest component of the supply cost



Bulk density is the most critical property of biomass

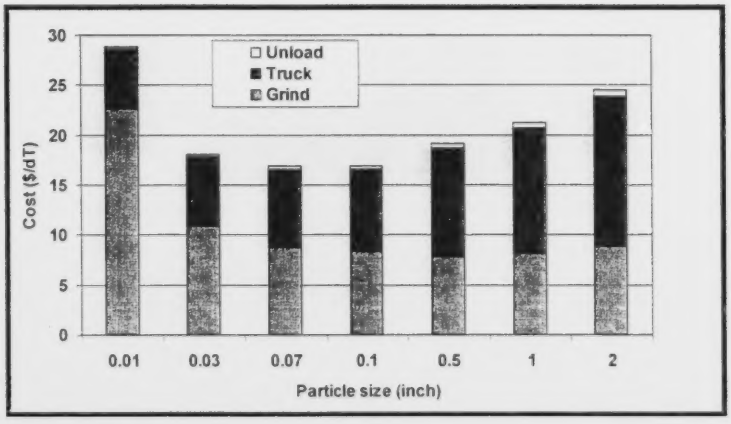


238 dry t/h using a 2.4 m x 3 m x 12 m container
Total unload time 9 minutes

Bulk density of switchgrass

Form of biomass	Shape and size characteristics	Density (kg/m^3)
Chopped biomass	20-40 mm long	60
Ground particles	1.5 mm loose fill	120
Ground particles	1.5 mm pack fill	200
Briquettes	32 mm diameter x 25 mm thick	350
Cubes	33 mm x 33 mm cross section	400
Pellets	6.24 mm diameter	500-700

Biomass densification by reducing particle size

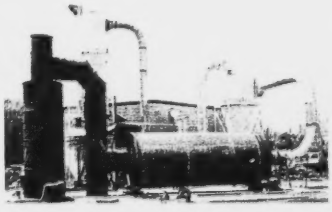


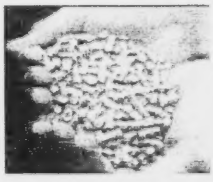
Further Developments

- Data on performance of field equipment vs. biomass yield
- Confirmation on bulk handling – in situ densification and unloading.
- Blending and mixing - cleaning
- Moisture management – wet and dry
- Integration with GIS data for logistics
- Aggregate to regional and nationwide supply systems
- Granulation
- Value-add supply chain

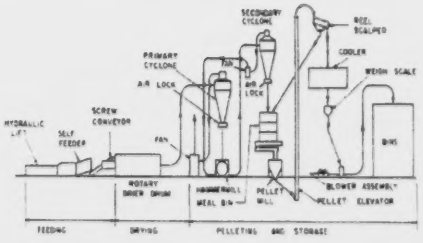
Pelletization







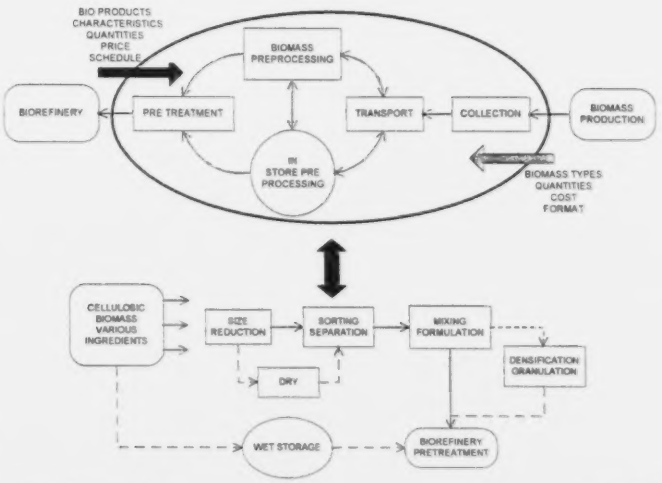
Bulk density 60 kg/m^3



Bulk density 600 kg/m^3

Integrated Biomass Supply Logistics

2006



Conclusions

- Technologies can be optimized to collect and deliver biomass for short distance delivery (40-60 km) at a cost of $35-45/dry ton.
- Biomass particle size for biorefinery is an important characteristics for selecting pre processing and transport logistics.
- Biomass densification (granulation) is essential to cope with long distance large scale biomass delivery.

ABOVE BOARD TECH.

Kamsack

Your Hosts

Ray Rondeau
Dale Legare

ABOVE BOARD TECH.

- WHAT ARE WE ABOUT?
- First plant in the world to make 7/16" structural panels from #1 and #2 wheat straw

Take a good look at the board sample

Do you recognize the product ?

Structurally it can be used the same as Oriented Stand Board (OSB) or Ply Wood

Gee it actually looks quite attractive !!!!

Common straw our key ingredient

Structural 1 Board is what again?

Structural **1** panels are for use where shear and cross-panel strength are extra important.

- **California** is an example of a Seismic Risk area were structural 1 panel will provide greater strength on the width and axis.

- Essentially the highest quality structural board as recognized by any building code council.

What do we start with?

Something pretty common and well known to everyone here.

Just plain ordinary Wheat straw. Stuff some people just Burn away

Let's take a look at some straw

What do we start with?
Conventional Straw



Seriously Conventional Wheat Straw!

- I though the only board that you could make with straw is particle board or MDF ?
- Yeah and where are they now ! All gone unfortunately!!!
- And what makes us different
- The price that we all pay for structural board versus particle board

Value Conversion process

- We are developing the value creation process in Kamsack at the pilot scale manufacturing facility
- What are some of the obstacles to full scale commercial production??

Let's start with what make's up 95 % of our product.

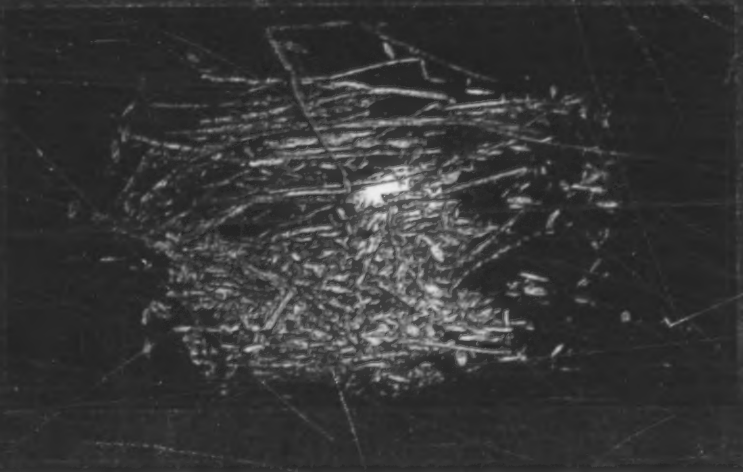


conventionally combined straw

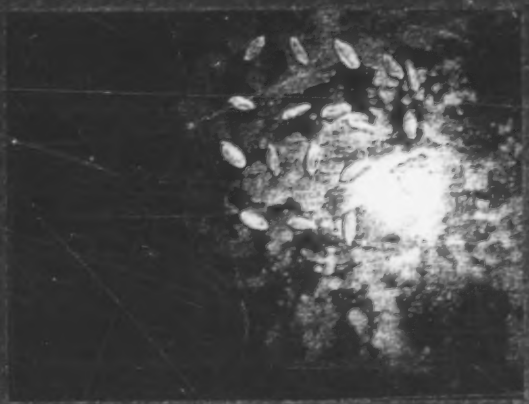
What don't we want



What does this separate to?



AND!!!



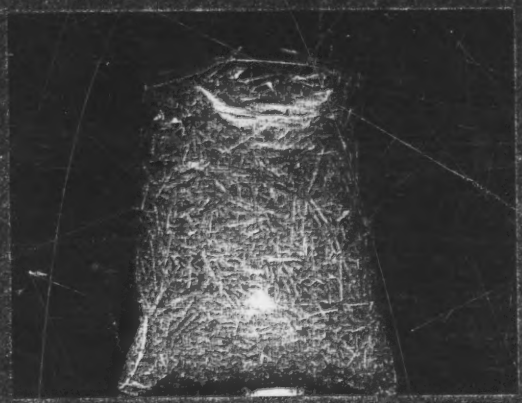
- This came from one handful of conventional Straw

Why is that not Good

- Causes problems throughout the production process
- Required Board Strength properties are hard to attain
- Increases **cost** of production
- **Slows** the production process

What about rotary combined straw?

- Well let' take a look.



OK Maybe a closer look



So What's wrong with this picture



- It's called fines. This all came from that one little bag

Again what's wrong with that!

- Our own process creates more fines.
- The previous sample at our door weighed **49 %** Fines

Fines are not good!!!

- **Detracts from board strength and thus creates Quality failures**
- **Slows production and adds costs**

Value Conversion

- The better, the faster, good boards with no rejects, the greater the value off the production line

- **The only input of varying quality is straw**
  - This industry will depend entirely upon a straw that is of a **higher quality** than what we have now.
  - This industry will depend on a **consistent quality and volume** of straw available.

Straw Cost Made of

Straw cost itself

- **Cost of baling , loading and transporting to the plant**

- **The straw, chaff, seeds, all paid for that are not required or detract from adding value to the product**

Our straw is split. Let's see

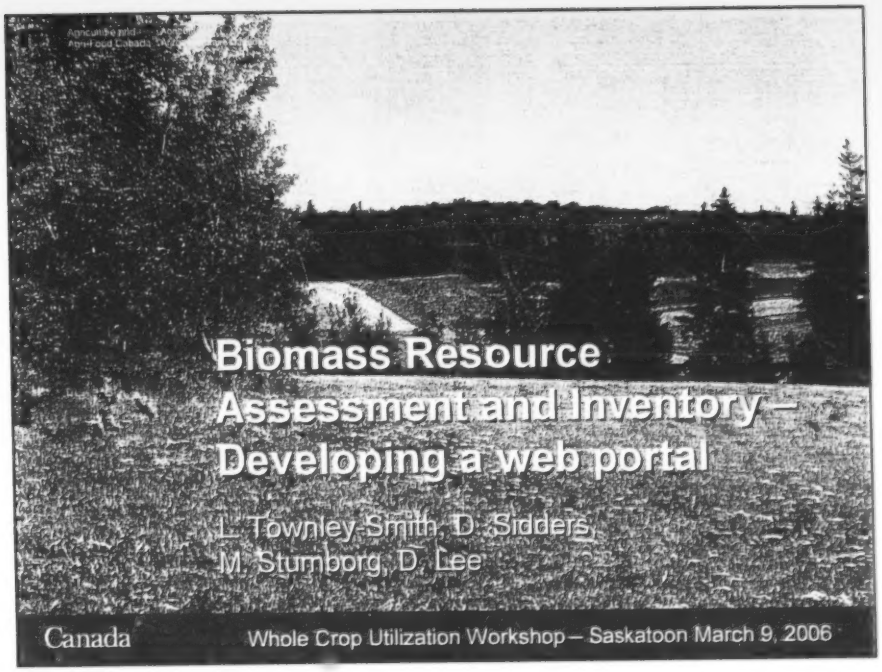


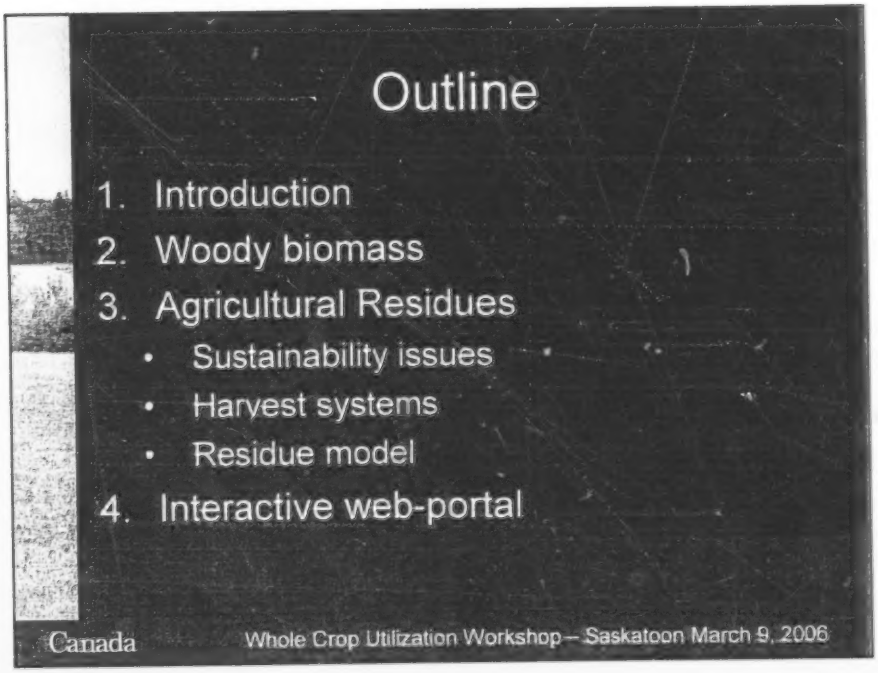
Ideal Straw to the process

- 3" to 4" in length
  - As wide as possible
  - **Moisture range of 8 to 10%**

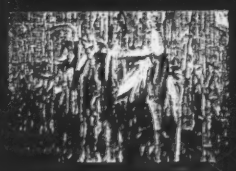
Value Creation For Producers

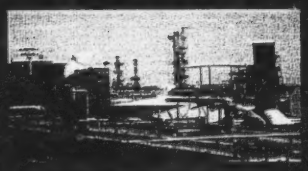
- The better the straw and the cheaper the straw harvesting and delivery process is the greater the value is to us the consumer of straw and the producer of structural board
  - **The grain producer must find new sources** of value to ensure survival of grain production as we know it


Biomass Resource Assessment and Inventory – Developing a web portal
L. Townley-Smith, D. Sidders, M. Stumborg, D. Lee
Canada
Whole Crop Utilization Workshop – Saskatoon March 9, 2006


Outline
1. Introduction
2. Woody biomass
3. Agricultural Residues
• Sustainability issues
• Harvest systems
• Residue model
4. Interactive web-portal
Canada
Whole Crop Utilization Workshop – Saskatoon March 9, 2006

Federal Vision : An Integrated Industry





Biomass Feedstocks

Trees
Grasses
Agricultural Crops
Agricultural Residues
Animal Wastes
Municipal Solid Waste

Bioconversion Biorefining

Enzymatic Fermentation
Gas/liquid Fermentation
Acid Hydrolysis/Fermentation
Gasification
Combustion
Co-firing

USES

Fuels:
Ethanol
Renewable Diesel

Electricity

Heat

Chemicals
Plastics
Solvents
Pharmaceuticals
Chemical Intermediates
Phenolics
Adhesives
Furfural
Fatty acids
Acetic Acid
Carbon black
Paints
Dyes, Pigments, and Ink
Detergents

Food and Feed

Outline

1. Introduction
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CFS CANADIAN FOREST SERVICE
SCF SERVICE CANADIEN DES FORÊTS

Opportunity Sources of Woody Biomass

- Logging Operations Residue
- Mill Processing Facilities Residue
- Forest Fire Salvage
- Insects and Disease Salvage

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Logging Residues

- Assess harvest residue
- Assess methods for capturing residues
- Assess economic effectiveness

(Forest Engineering Research Institute of Canada)



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Canada

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Mill Residue

- Obtain National (2004) Database
- Spatialize Data
- Integrate with other information resources





Natural Resources Canada | Ressources naturelles Canada

Canada

CFS CANADIAN FOREST SERVICE
SCF SERVICE CANADIEN DES FORÊTS

Forest Fire Salvage

- Identify & map burned areas
- Acquire salvage harvesting information and integrate with spatial database
- Assess economic potential



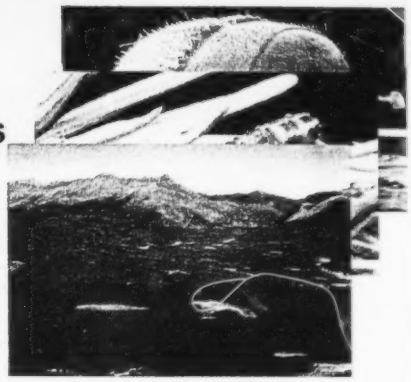
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Canada

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SCF SERVICE CANADIEN DES FORÊTS

Insects and Disease Salvage

- Identify Insect / Disease
- Identify affected areas
- Assess salvage potential
- Assess economic viability

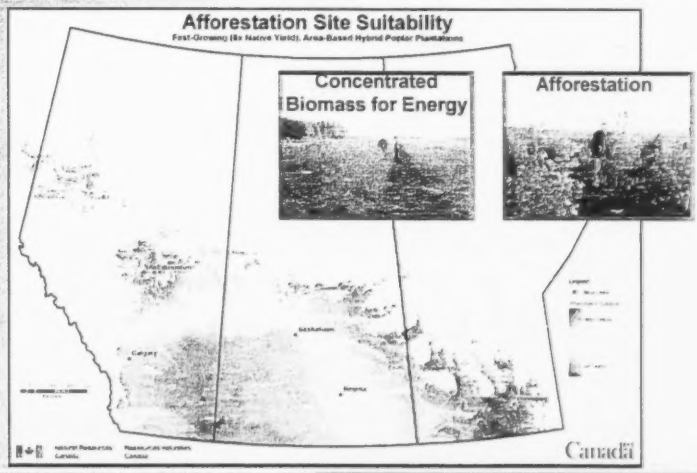


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Canada

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Adapt Site Suitability & Yield Potential Model to Woody, Purpose Grown Feedstocks



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Canada

Outline

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Is Residue Removal Sustainable?

- **AAFC Straw Removal Study**
  - Removed 2/3 of available straw for 30 Yrs
  - Organic N was lowered but is replaced by fertilizer N.
- **USDA Study**
  - Majority of soil carbon and N contributed by roots.
  - Surface residues contribute <20% of soil N.

SPARC Chaff Collection Project

After 8 years of chaff collection at Melfort and Swift Current, SK

- No impact on crop productivity.
- No impact on soil quality.
- No impact on erodibility.
- Weed seed collection related to timing of harvest.
- Chaff available even during drought.





Crop residue and erosion

- Crop residue is important in preventing erosion
  - Ground cover and soil binding for water erosion
  - Creation of boundary layer for wind erosion
- How much crop residue is needed?
  - Varies with soil, landscape and climate
  - Estimated at 750 to 1500 kg/ha
  - Sufficient to keep erosion at or below the...
- Sustainable erosion rate
  - Point at which soil loss is balanced by soil creation
  - Varies with soil/landscape
  - Estimated through erosion impact model analysis

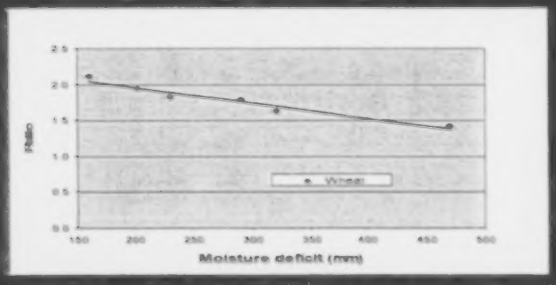
GIS Inventory System for Crop Residues

Methods

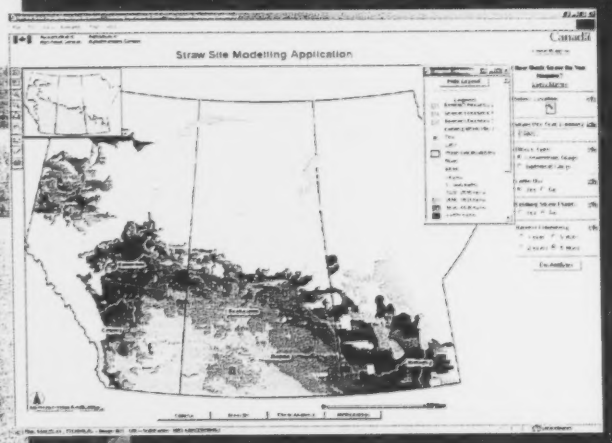
- Map base
  - Soil Landscapes of Canada
  - Major roads and railroads
  - Land cover
- Straw production calculation
  - Land area in crop - 1996 Census of Agriculture
  - Crop yield – derived from provincial Crop Insurance Data
  - Straw Grain ratio (PAMI data)
- Straw conservation requirement
  - Conservation tillage - 750 kg/ha
  - Conventional tillage - 1500 kg/ha
  - Will be based on soil/climate characteristics
- Livestock use

GIS Inventory System for Crop Residues

Estimating MOG yield from grain production



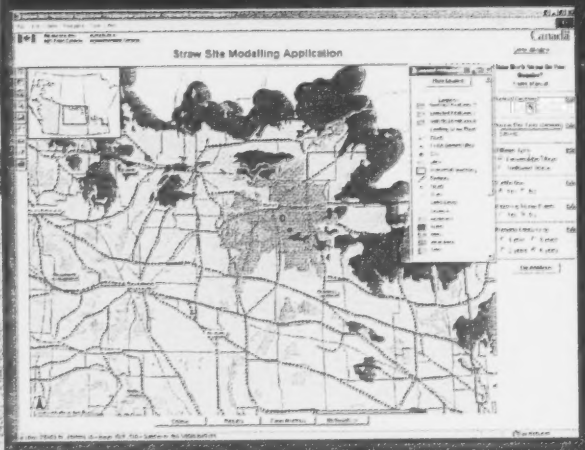
GIS Inventory System for Crop Residues



- brown area will supply the required straw
- background colour is straw yield (kg/ha)
- can select multiple sites to compare
- gaps in background are either non-cropland or don't have enough straw to meet conservation requirements

Screen shot – 3 locations chosen

GIS Inventory System for Crop Residues



- background is now land use
- roads and railroads now visible
- urban centers now visible
- tools allow distance measurement

GIS Inventory System for Crop Residues

Future Developments

- Add revised estimates for erosion protection
- Add individual crop estimates
- Expand to whole country
- Add corn stover
- Crop yield modeling
- LSRS

Outline

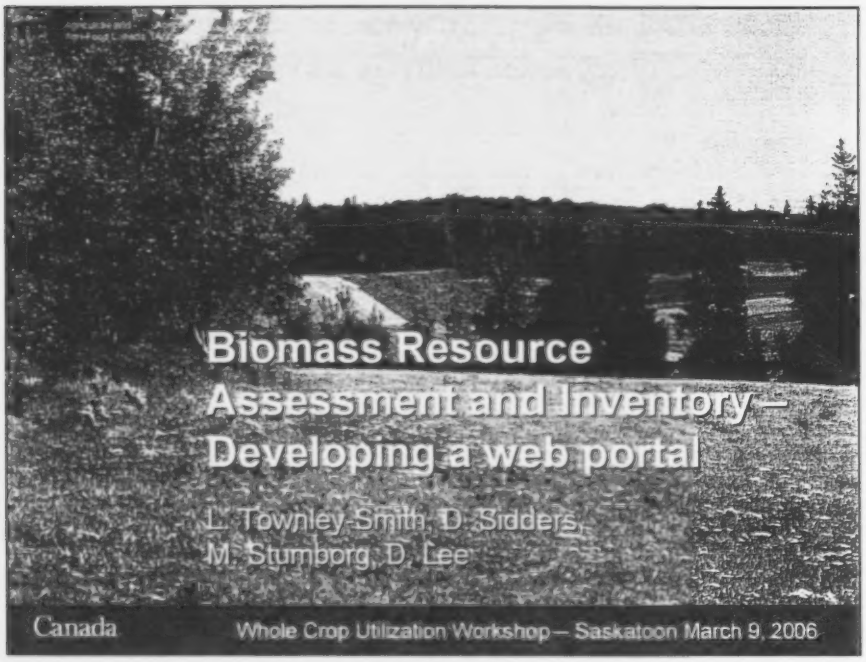
1. Introduction
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4. Interactive web-portal

Interactive Biomass Web Portal

- Model the quantity and quality of woody and herbaceous purpose grown and opportunity biomass across Canada
- Show the associated energy, water, and transportation infrastructure available for exploitation of the biomass resource
- Link the models to remote sensing technology to provide predictive capacity for biomass availability on an annual basis

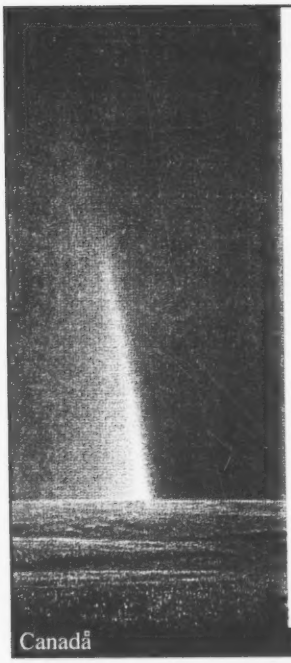
Interactive Biomass Web Portal

- Include economic models as available
- Provide the inventory to the private sector through a Web-based interactive GIS portal, to provide access to accurate and reliable biomass information
- Provide detailed quantity, quality, energy, and carbon/nitrogen cycle data to model and analyze the biomass system from soil to grave



Outline

1. Introduction
2. Woody biomass
   - Opportunity wood
   - Purpose grown
3. Agricultural Residues
   - Sustainability issues
   - Harvest systems
   - Residue model
4. Interactive web-portal



Harvesting for Seed & Straw
(a Work in Progress)

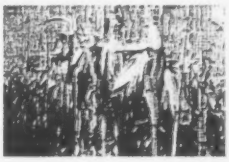
By: Mark Stumborg, P.Eng.

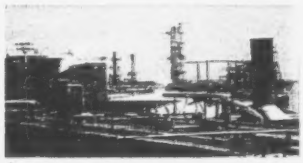
Assisted by:
Mark Covell, Engineering Technician
Clay Schwartz, Machinist

Objectives

1. Background
2. Describe the Challenges for Prairie Straw Harvest Systems
3. Describe the Progress to Date
4. Summary

The Opportunity: An Integrated Industry





Biomass Feedstocks

- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Animal Wastes
- Municipal Solid Waste

Bioconversion Biorefinings

- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Combustion
- Co-firing

USES

Fuels:
- Ethanol
- Renewable Diesel

Electricity

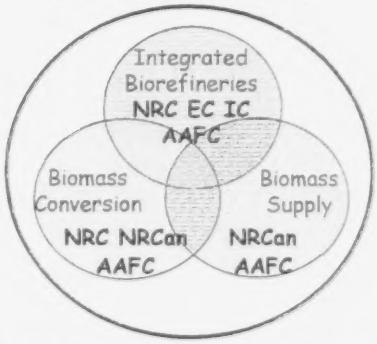
Heat

Chemicals
- Plastics
- Solvents
- Pharmaceuticals
- Chemical Intermediates
- Phenolics
- Adhesives
- Furfural
- Fatty acids
- Acetic Acid
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents

Food and Feed

Funding for the Harvest Activities

The Canadian Biomass Innovation Network (CBIN)



Funding provided by the Climate Change Technology & Innovation Program (T&I) & Panel on Energy R&D(PERD).

The Challenge

Change the current harvest system optimized to harvest grain to harvest three streams:

- Grain
- Straw
- Chaff





Why Three Streams ?

Seed:

1. Maintain or improve pre-harvest loss;
2. Maintain or improve overall harvest losses (header, shoe, walker/rotors); and
3. Maintain or improve harvested seed quality; and
4. Reduce overall harvest cost (capital & operating).

Why Three Streams ? (cont.)

Chaff:

1. Remove chaff from the field;
2. Improve the potential for chaff as a feed product separate from the other two streams; and
3. Keep chaff away from the straw;

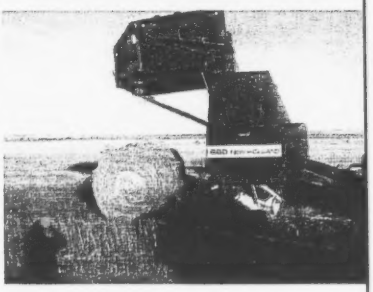
Why Three Streams ? (cont.)

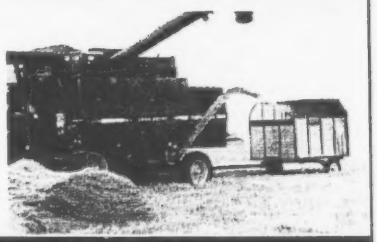
Straw:

1. Improve straw quality (less physical damage);
2. Improve straw yield;
3. Improve the harvest window for straw; and
4. Increase the area of sustainable straw harvest.

Current Systems

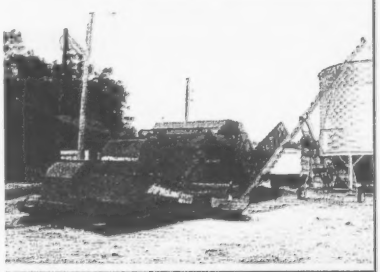
1. Add-ons following grain harvest.
2. Quality of chaff and straw is managed after the seed.
3. High cost systems because of the existing combine technology.





McLeod Harvest™ System

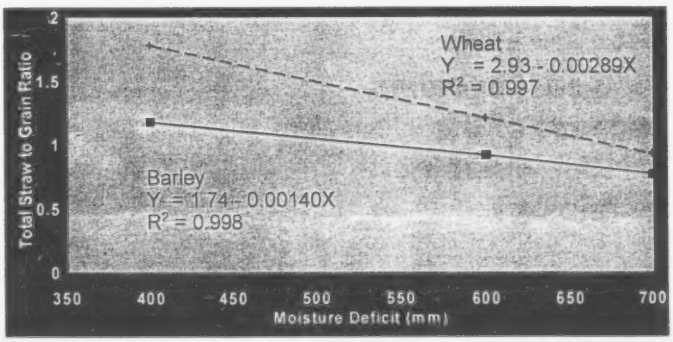
1. Gathers all types of seed and chaff together (graff).
2. In-yard separation of graff.
3. Yard processor densifies the separated material (millings).
4. Millings are suited for feed or, possibly, bioconversion.
5. Cost? Reliability? Suitability?





Harvest System Challenges

1. **Weather:**
   - In poor stands, straw recovered can be near zero.
   - Risk factor for biomass businesses.
   - Straw collection waits for seed harvest completion.



Harvest System Challenges (cont.)

2. **Producer Choices:**
   a. **Cutting height:**
      - Decreasing from 20 to 10 cm could increase straw harvest by ~50% with a negative impact on fuel, time, & cost.
      - Cutting height choice can be positive or negative for snow trapping.

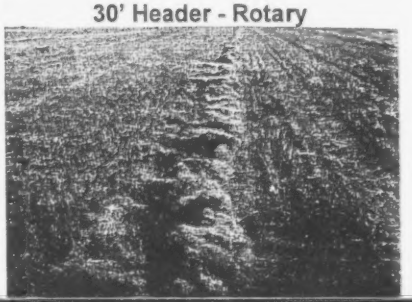
   b. **Agronomic system:**
      - Semi-dwarf cereals, fertility, and rotation may reduce biomass availability.

Harvest System Challenges (cont.)

c. Combine type: Rotary vs. Conventional Combines:

- Rotary combine: grinding action leaves less "baleable" straw.
- Rotary combine: grinding action may either enhance or worsen further processing.
- Conventional combines: less harvest capacity and increasingly difficult to purchase.

30' Header - Rotary

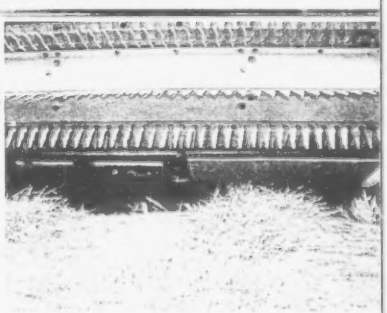


20' Header - Conventional



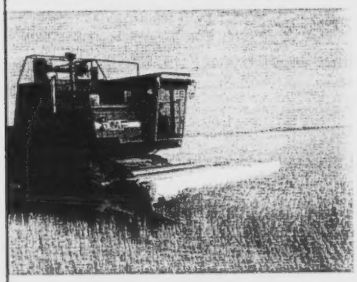
Harvest Systems R&D

1. Shelbourne Technology Within Existing Agronomic Systems
   - Cereal Systems
   - Flax Systems
   - Pulse Crops
   - Oilseeds

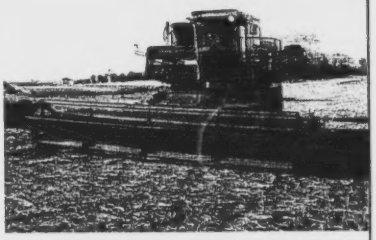


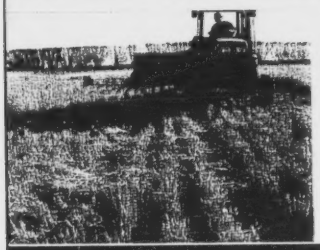
2. Information Collected:
   - Biomass Quantity and Quality;
   - Fuel Savings;
   - Opportunity Cost / Benefit;
   - GHG Savings;
   - Capital Cost Reductions;

Equipment: Based on Massey 550



Harvest





Baling

Binding

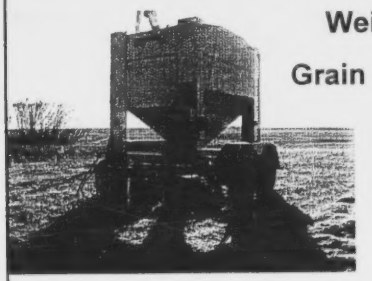


Weighing Equipment

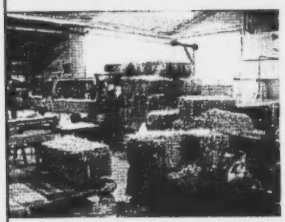
Weigh Wagons

Grain

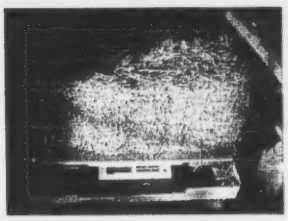
Chaff







Platform Scale

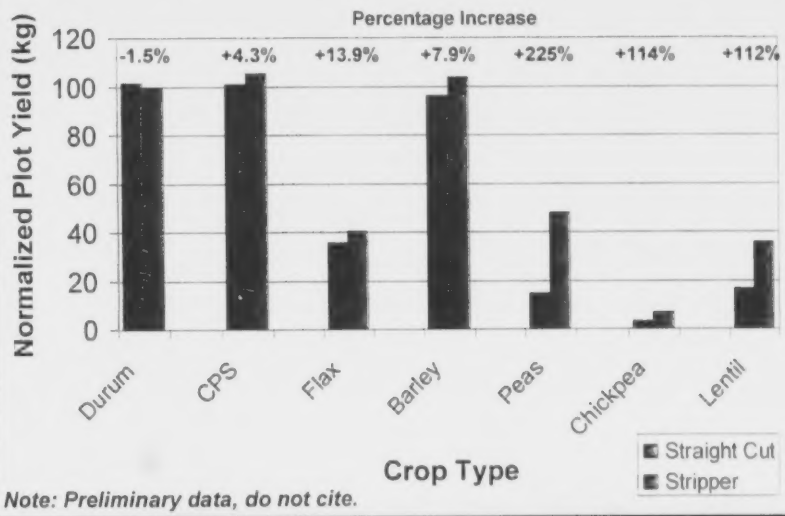


Harvest Seed Yields (2004)

1. **Lentils: Wheatland**
   - 20' Straight header = 24.6 bu ac^{-1}
   - Stripper header = 24.6 bu ac^{-1}
   - Swath & pick-up = 26.7 bu ac^{-1}

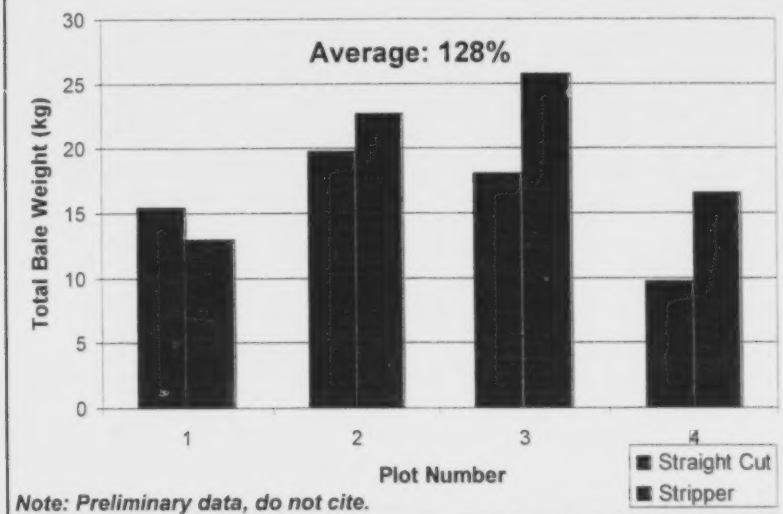
2. **Chick Peas: Wheatland**
   - 20' Straight header = 7.8 bu ac^{-1}
   - Stripper header = 7.8 bu ac^{-1}

Small Plot Grain Yields (2005)



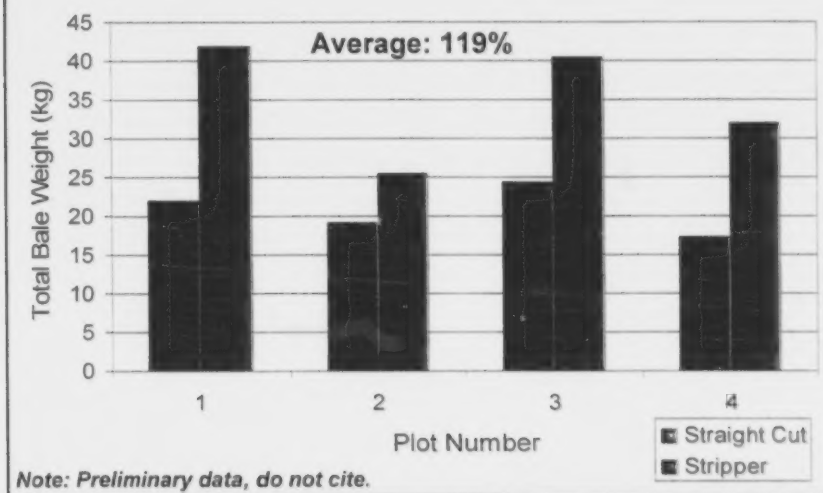
Note: Preliminary data, do not cite.

Comparison of Flax Bale Yield

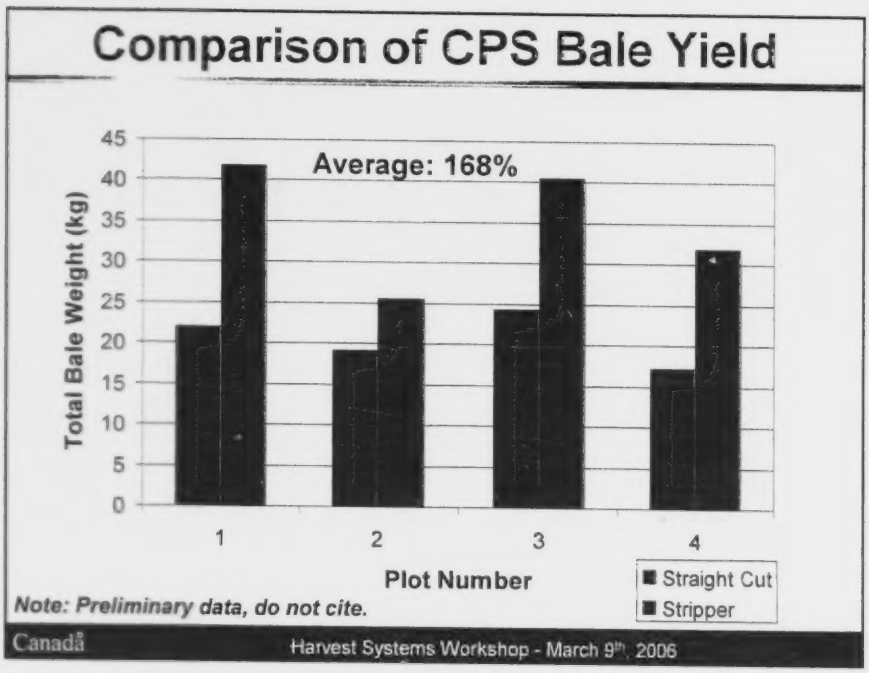


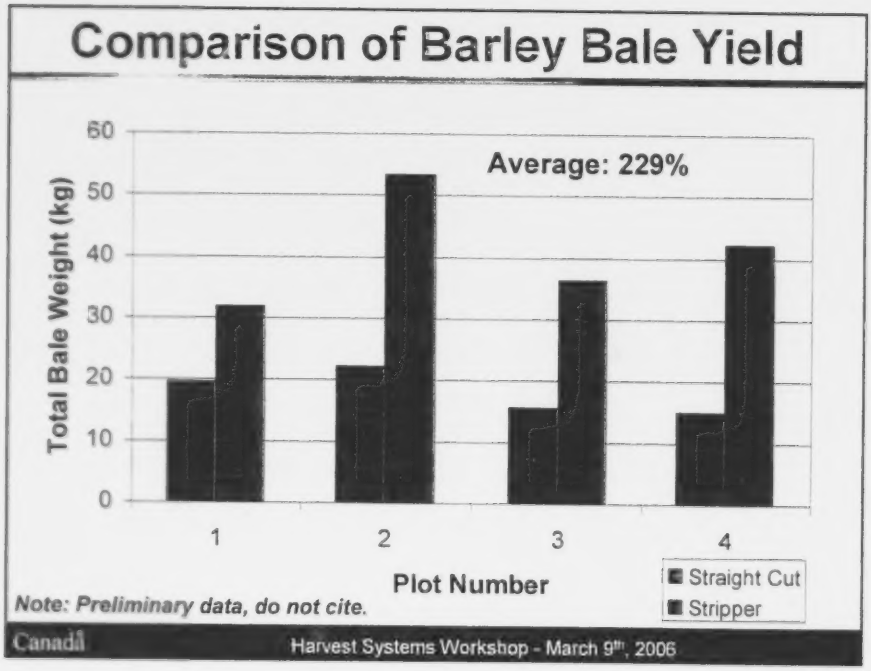
Note: Preliminary data, do not cite.

Comparison of Durum Bale Yield



Note: Preliminary data, do not cite.


Comparison of CPS Bale Yield
Average: 168%
Total Bale Weight (kg)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
Plot Number
Straight Cut
Stripper
Note: Preliminary data, do not cite.
Canada
Harvest Systems Workshop - March 9th, 2006

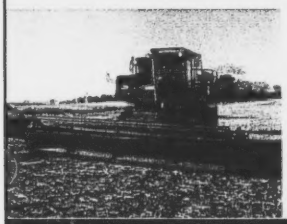
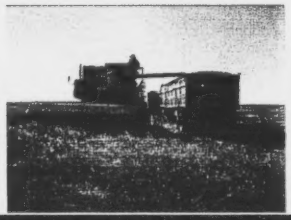

Comparison of Barley Bale Yield
Average: 229%
Total Bale Weight (kg)
60
50
40
30
20
10
0
1
2
3
4
Plot Number
Straight Cut
Stripper
Note: Preliminary data, do not cite.
Canada
Harvest Systems Workshop - March 9th, 2006

Harvest Seed Yields (2005)

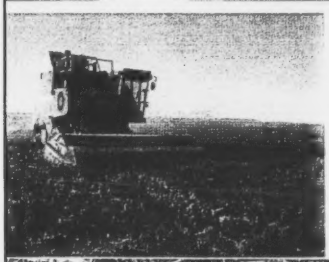
Flax Harvest @ Lyle Simonson Farm

80 Acres Split into 3 Large Plots

- Case IH = 25.7 bu ac^{-1}
- Massey 550 & 20' header = 24.6 bu ac^{-1}
- Massey 550 & Stripper header = 25.7 bu ac^{-1}

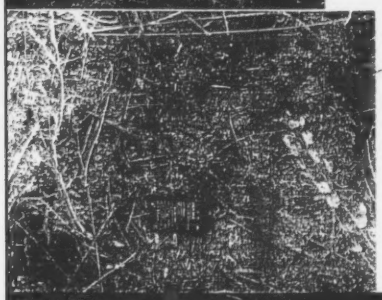




Stripper Header in Flax: Wright Farm



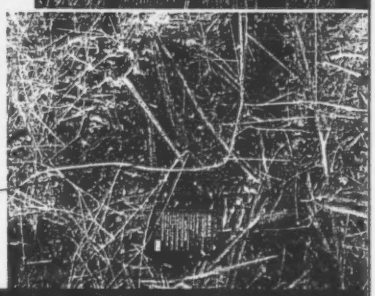
Final Straw Height:

24 – 26"

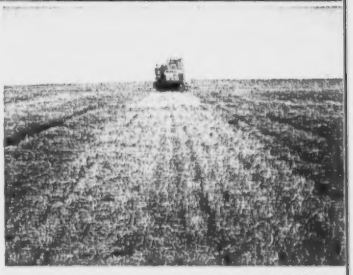
Gleaner - Hired Operator

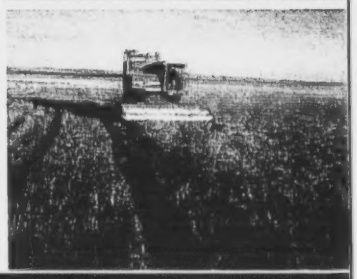
Stripper



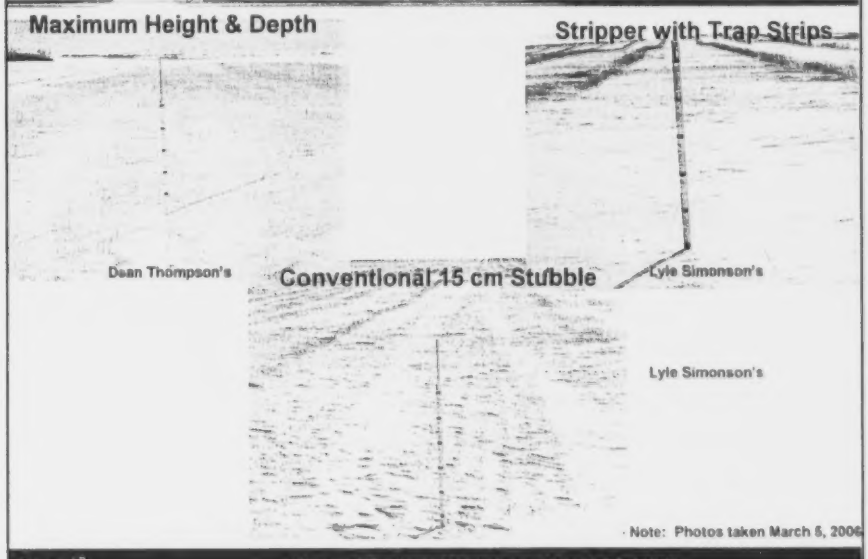
Seed Quality

1. **Malting Barley:**
   - Stripper leaves many awns & cleaner sample.
2. **Lentils:**
   - Leaves 10 – 12" stubble.
   - No dirt & few cracks or peels.
3. **Flax:**
   - Works with tough straw.
   - Less overall loss
4. **All crops: picks up down material (lodged, tracks, sawfly, etc.)**





Snow Trapping - Flax



Snow Trapping - Lentils

Starting Residue Cover



Snow Cover



Note: Photos taken March 3, 2006

Prairie Harvest Systems R&D

1. **Cooperation with the Climate Change, Biomass Energy, and other agencies.**
   - NSERC & UBC
   - Producers
   - APF Flax Initiative
   - USDA & USDOE
2. **Cooperation with Industrial Partners**
   - Dow
   - Schweitzer-Mauduit
   - Iogen
   - Case New Holland

APF Flax Initiative

1. **Schweitzer-Mauduit & Simonson Farms**
   - Pulp fibre for fine paper.
   - Harvest impact on final fibre yield.



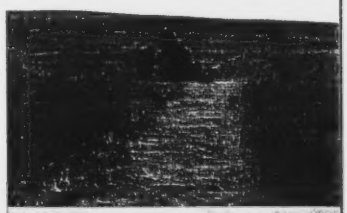




APF Flax Initiative

2. **Biolin Research & Thompson Farms**
   - Fibre for composites, textiles & other material uses.
   - Harvest impact on fibre quality.

Cutting Treatments



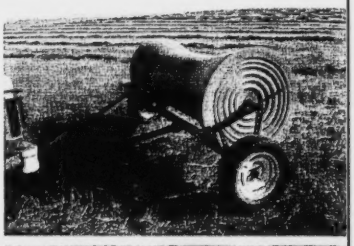


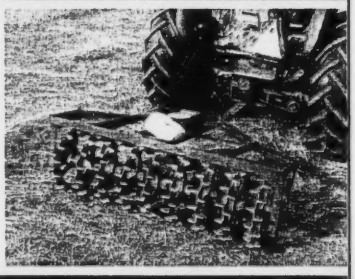


Improving Retting

Packing Treatments







Future Thoughts

1. **Large scale demonstrations: Straight cut vs. Stripper technology**
   - Straw yield;
   - Straw quality;
   - Energy, time, and machine depreciation impacts.
   - Impact on following crop if not harvested.

2. **Continued evaluation of biomass for thermal, physical, and biological processes.**
   - Industrial cooperators;
   - NGO's
   - Federal partners.

Future Plans

3. **Development of optimized harvester.**

   Takes advantage of:

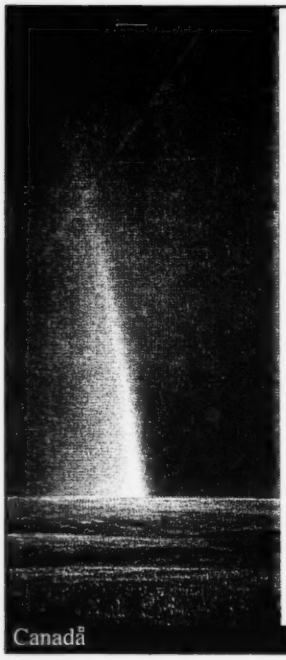
   - **Energy savings of the stripper header;**
   - **Existing equipment (forage tractor);**

   Producer benefits;

   - **Lower harvest cost**
   - **Reduced time**
   - **Improved seed quality**
   - **Biomass options**

Acknowledgements

1. **SPARC Staff & Resources**
2. **Natural Resources Canada**
3. **Wheatland Conservation**
4. **Farm Cooperators**
5. **PAMI**
6. **Schweitzer-Mauduit**
7. **Biolin Research**
8. **Iogen Corp.**
9. **Above Board**



Thank You for Your Attention !

Questions ?

Canada

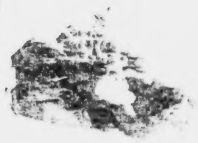
Harvest Systems Workshop - March 9th, 2006

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CETC CANMET ENERGY TECHNOLOGY CENTRE

CELLULOSIC ETHANOL PRODUCTION: AN OVERVIEW OF FEEDSTOCKS & PROCESSES

WHOLE CROP UTILIZATION WORKSHOP
SASKATOON, SASKATCHEWAN
9 MARCH 2006



Canada

CETC CANMET ENERGY TECHNOLOGY CENTRE



Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Presentation Outline

- Processes
- Feedstocks
  - composition
  - specifications
- Discussion

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CETC CANMET ENERGY TECHNOLOGY CENTRE

Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Feedstocks – Composition (Average (%)

	Cellulose	Hemicellulose	Lignin
Wheat Straw	37	23	19
Barley Straw	36	23	19
Corn Stover	39	26	15

Other
- Protein ~ 3
- Ash ~ 8
- Extractives ~8

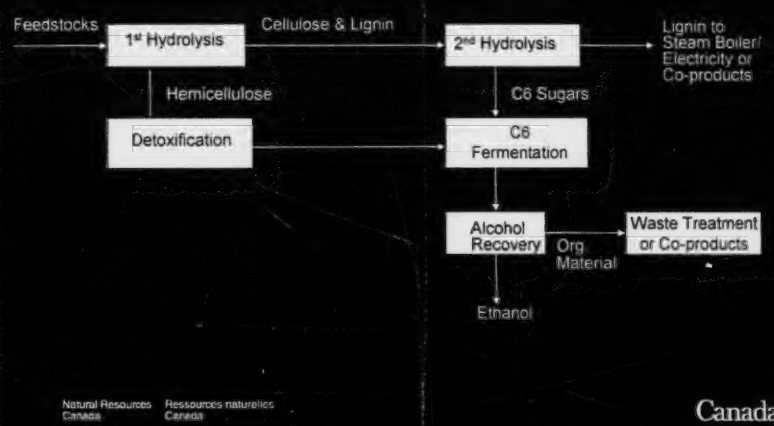
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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Dilute Acid Process



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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Dilute Acid Process – Plus/Minus

Plus	Minus
Simple	Materials Compatibility
Cheap	Acid Disposal
Low Tech	Degradation Products

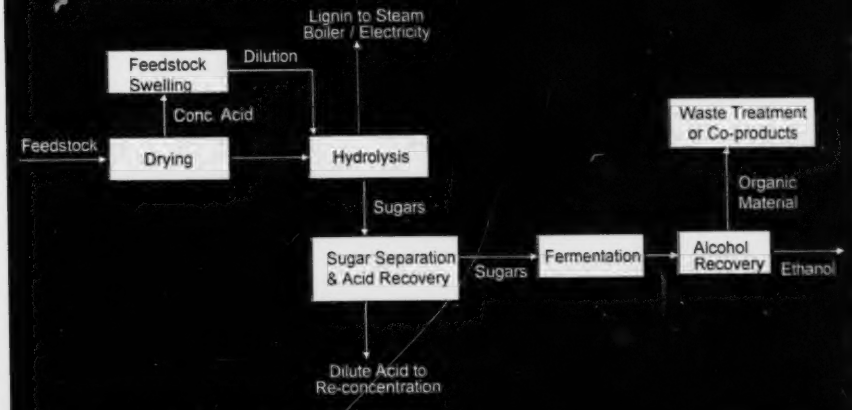
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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Concentrated Acid Process



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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Concentrated Acid Process – Plus/Minus

Plus	Minus
Simple	Materials Compatibility
Cheap	Acid Recovery
Low Tech	Acid Handling

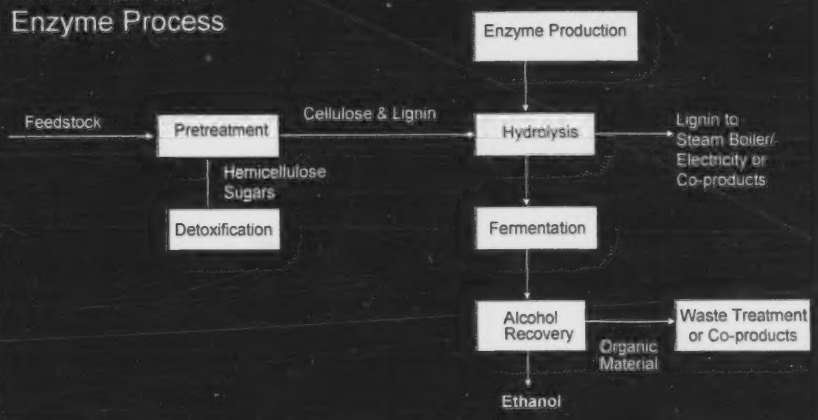
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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Enzyme Process



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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

Enzyme Process – Plus/Minus

Plus	Minus
Benign	Currently Expensive
Possibly Cheaper	Complex
No Degradation Products	
High Biotech	

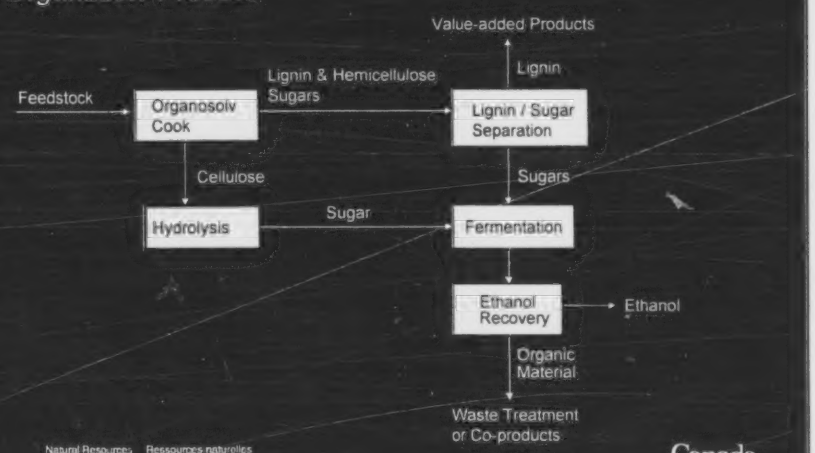
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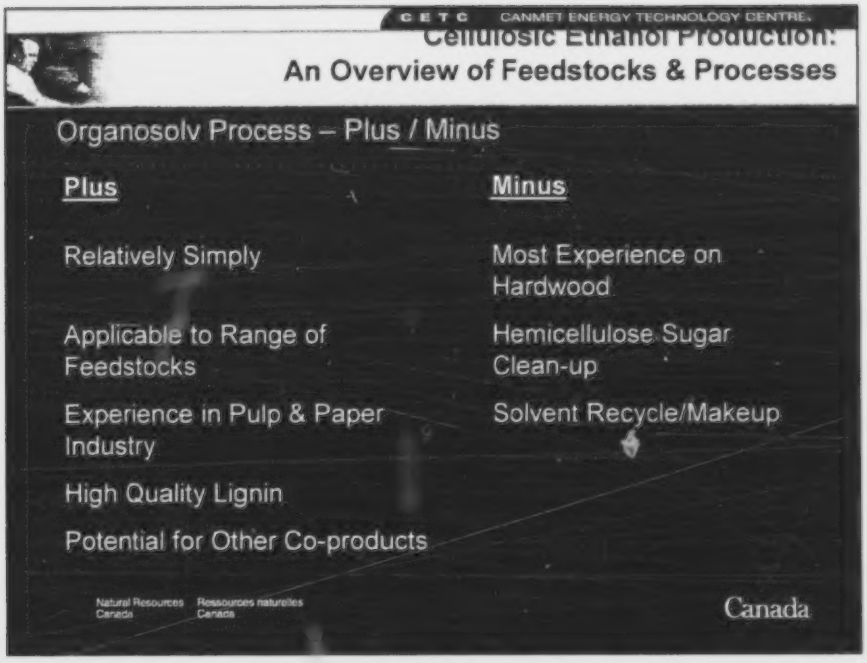
Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

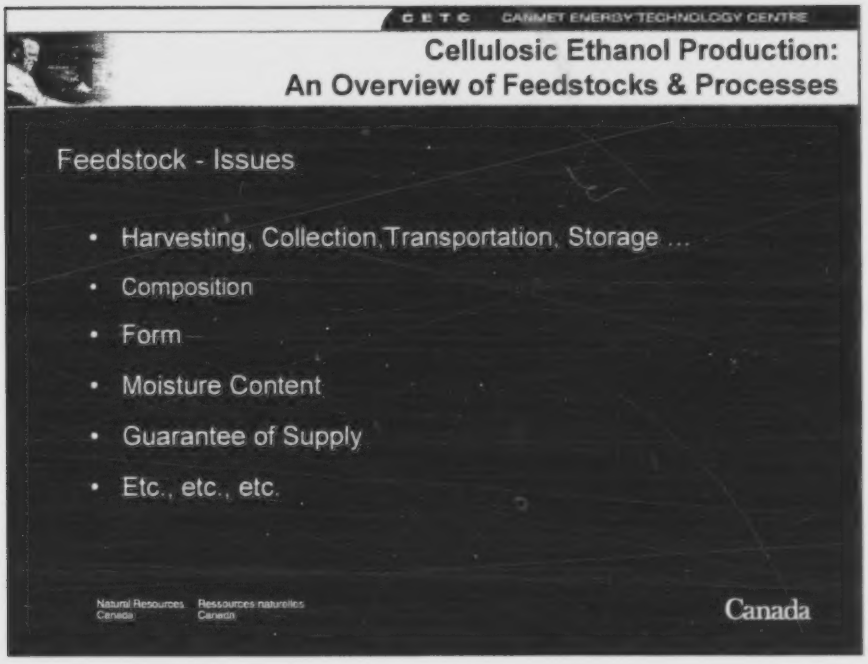
Organosolv Process



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CETC CANMET ENERGY TECHNOLOGY CENTRE
Cellulosic Ethanol Production:
An Overview of Feedstocks & Processes
Organosolv Process – Plus / Minus
Plus
Relatively Simply
Applicable to Range of Feedstocks
Experience in Pulp & Paper Industry
High Quality Lignin
Potential for Other Co-products
Minus
Most Experience on Hardwood
Hemicellulose Sugar Clean-up
Solvent Recycle/Makeup
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Cellulosic Ethanol Production:
An Overview of Feedstocks & Processes
Feedstock - Issues
• Harvesting, Collection,Transportation, Storage ...
• Composition
• Form
• Moisture Content
• Guarantee of Supply
• Etc., etc., etc.
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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

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- Protein ~ 3
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Cellulosic Ethanol Production: An Overview of Feedstocks & Processes

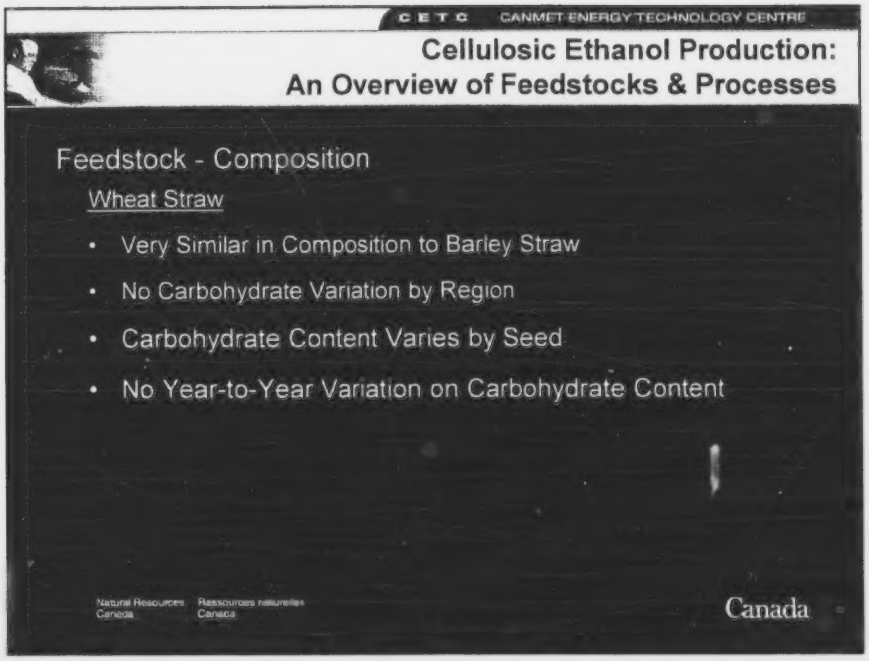
Feedstock - Composition

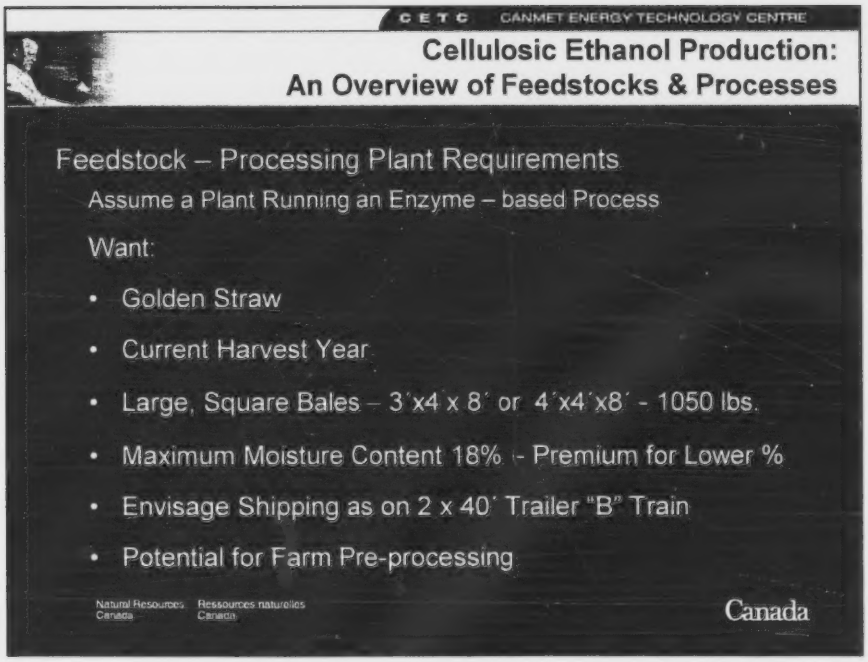
Barley Straw

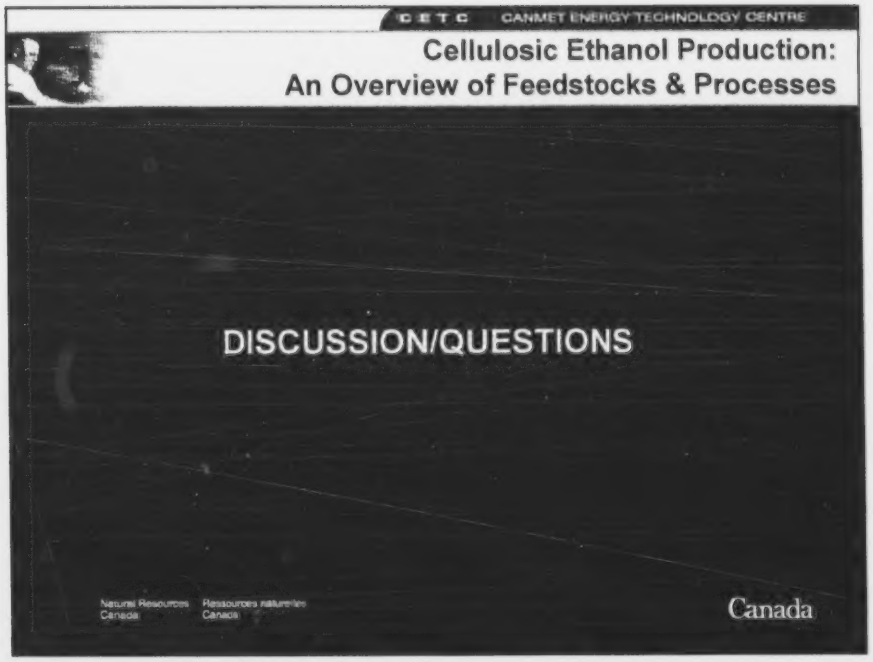
- Carbohydrate Content Dependent on Seed Variety
- Carbohydrate Content Appears to Also Vary by Region
- Grain Arrangement Has no Effect on Carbohydrate Content
- No Year-to-Year Variation on Carbohydrate Content

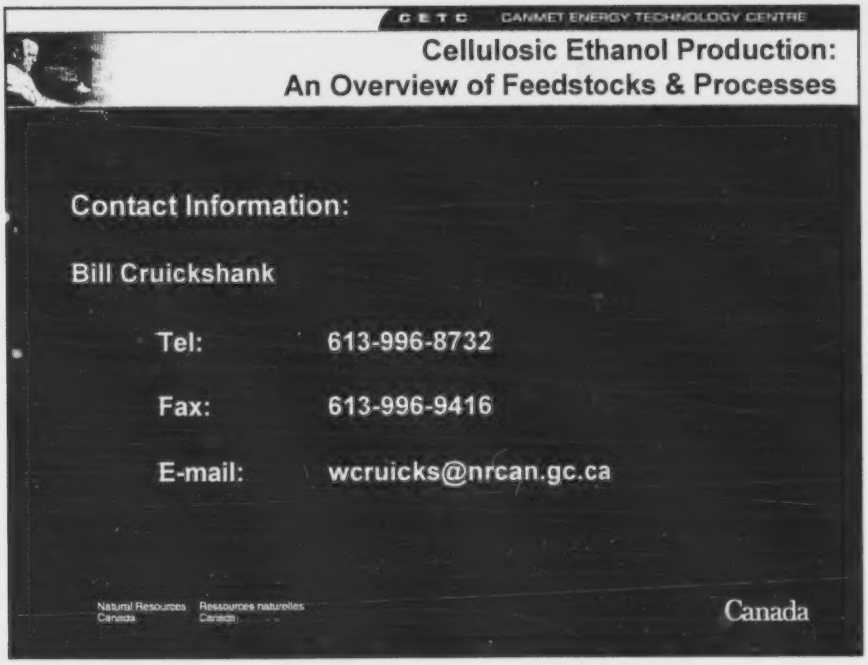
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Cellulosic Ethanol Production:
An Overview of Feedstocks & Processes
Feedstock - Composition
Wheat Straw
• Very Similar in Composition to Barley Straw
• No Carbohydrate Variation by Region
• Carbohydrate Content Varies by Seed
• No Year-to-Year Variation on Carbohydrate Content
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Cellulosic Ethanol Production:
An Overview of Feedstocks & Processes
Feedstock – Processing Plant Requirements
Assume a Plant Running an Enzyme – based Process
Want:
• Golden Straw
• Current Harvest Year
• Large, Square Bales – 3´x4 x 8´ or 4´x4´x8´ - 1050 lbs.
• Maximum Moisture Content 18% - Premium for Lower %
• Envisage Shipping as on 2 x 40´ Trailer "B" Train
• Potential for Farm Pre-processing
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Cellulosic Ethanol Production:
An Overview of Feedstocks & Processes
DISCUSSION/QUESTIONS
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Cellulosic Ethanol Production:
An Overview of Feedstocks & Processes
Contact Information:
Bill Cruickshank
Tel: 613-996-8732
Fax: 613-996-9416
E-mail: wcruicks@nrcan.gc.ca
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Ressources naturelles Canada
Canada

CETC CANMET ENERGY TECHNOLOGY CENTRE

Fernando Preto

Straw Quality: Issues for Conversion

Whole Crop Utilization Workshop
Regina, March 6, 2006



Canada

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Energy production from Straw

Objective

To evaluate straw properties (physical and chemical composition) and handling requirements as well as selecting suitable pre-treatment (drying, densification) technologies for each thermochemical conversion technology

Work Plan

Chemical analyses of straw samples carried out to determine composition (C,H, N, O, S), energy content (HHV and moisture) and ash composition (metals content)

Quantification of straw samples for lignin, cellulose and hemicellulose content

Samples of straw materials have been obtained and pretreated where required and are being processed by fast pyrolysis, gasification and combustion to evaluate both handling and conversion issues

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Fuel Analysis: Wheat Straw

SAMPLE COMMENT / DESCRIPTION: Wheat Straw

PROXIMATE ANALYSIS (WT%)

	As Analyzed	Dry Ash Free
Moisture (ASTM D 5142)	9.63	
Ash (ASTM D 5142)	6.49 ← High	
Volatiles (ISO 562)	66.11	78.81
Fixed Carbon (by diff)	17.77	21.19

ULTIMATE ANALYSIS (WT%)

	As Analyzed	Dry Ash Free
Carbon (ASTM D 5373)	41.47	49.44
Hydrogen(ASTM D 5373)	5.04	6.01
Nitrogen(ASTM D 5373)	0.47	0.56
Sulphur (ASTM D 4239)	0.07	0.08
Oxygen (by Diff)	36.83	43.91

CALORIFIC ANALYSIS (ISO 1928)

	As Analyzed	Dry Ash Free
Cal/g	3868	4611
MJ/Kg	16.19	19.31
BTU/LB	6962	8300

CETC CANMET ENERGY TECHNOLOGY CENTRE

Fuel Analysis: Wheat Straw Ash

TEST RESULTS - X-ray Fluorescence - @XRFFP2

Protocol Name	Test Name	Method	Value	
Majors & Minors	SiO2	ASTM D 4326	73.66	wt%
"	Al2O3	ASTM D 4326	0.54	wt%
"	Fe2O3	ASTM D 4326	0.16	wt%
"	TiO2	ASTM D 4326	<0.03	wt%
"	P2O5	ASTM D 4326	1.02	wt%
"	CaO	ASTM D 4326	1.56	wt%
"	MgO	ASTM D 4326	1.47	wt%
"	SO3	ASTM D 4326	0.93	wt%
"	Na2O	ASTM D 4326	0.09	wt%
"	K2O	ASTM D 4326	7.79	wt% ← High
"	Barium	ASTM D 4326	867	ppm
"	Strontium	ASTM D 4326	82	ppm
"	Vanadium	ASTM D 4326	<50	ppm
"	Nickel	ASTM D 4326	<50	ppm
"	Manganese	ASTM D 4326	415	ppm
"	Chromium	ASTM D 4326	<50	ppm
"	Copper	ASTM D 4326	31	ppm
"	Zinc	ASTM D 4326	51	ppm
"	Loss on Fusion	ASTM D 4326	11.55	wt%
"	Sum	ASTM D 4326	98.92	wt%

What can the analytical data tell us?

It depends on the conversion technology

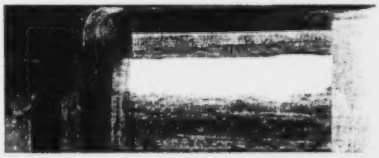
Combustion	>800 C
Gasification	600 – 700 C
Fast Pyrolysis	450 – 550 C
Torrefaction	200 – 300 C
Biochemical Conversion	

High Temperature Conversion in Air

In high temperature processes (combustion and gasification) the components of straw break down into oxides of the basic elements C, H, N, S plus ash.

The form of the components can influence kinetics and reaction rates. This is less critical for combustion than other processes where the reaction time can influence the conversion to syngas or "bio-oil".

What are the issues for "high temperature" combustion?



Combustion Utilization Barriers

Fuel Property	Characteristics	Potential Problem	Proposed Solution
High Alkali (Na, K)	Formation of low-melting-point compounds	Slagging/fouling of convective surfaces	Low convective pass temperature (~1400°F) Sootblowing
		Sintering on the grate	Low firing temperature Fuel mixing (dilution)
Chlorine	Formation of alkali chlorides and HCl	Corrosion	On-grate chlorine capture Fuel mixing dilution
	Formation of chlorinated organic compounds	Emissions exceeding local, state, or federal limits	Combustion air and temperature control
Bulk Density	Low bulk density	High transportation costs	Baling (compacting)
		High processing costs	Hydraulic ram feeder Fuel preparation

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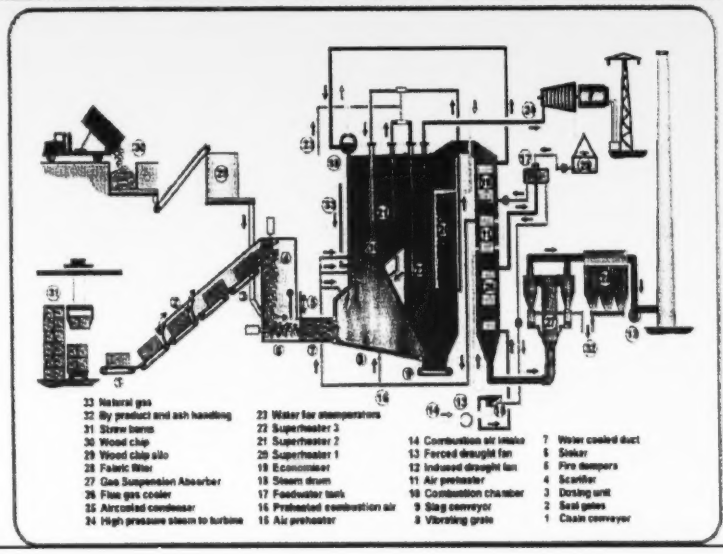
Combustion: Physical Form

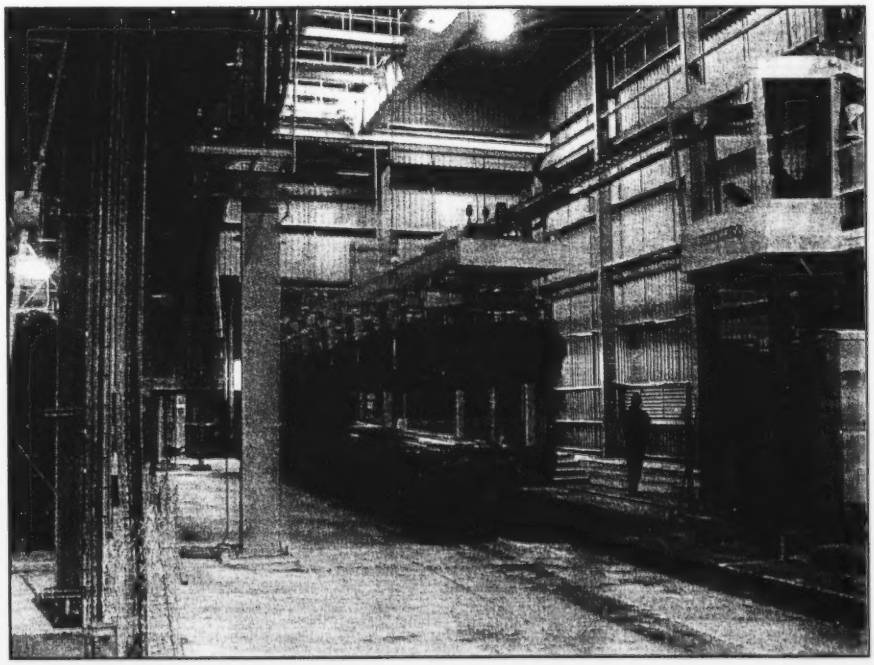
The limitation for combustion systems is the handling and shredding necessary to properly feed the straw into the furnace. There are a number of possible approaches:

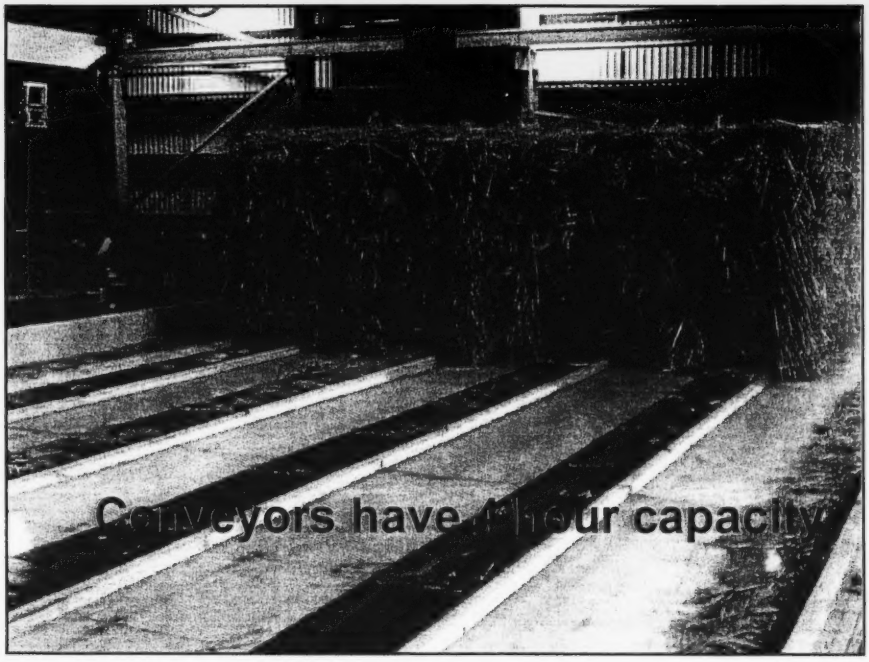
1. **Shred bale and feed loose straw**
2. **Shred bale and shred straw to feed fine particles**
3. **Feed whole bale (Cigar or "Front Edge" Burning)**
4. **Pelletize straw and feed pellets**

Methods 1 and 3 are recommended for combustion. Method 2 may cause incomplete burning and elevated particulate emissions unless special precautions are taken. Method 4 may be used for combustion but requires additional energy input and pellets could exacerbate clinkering problems.

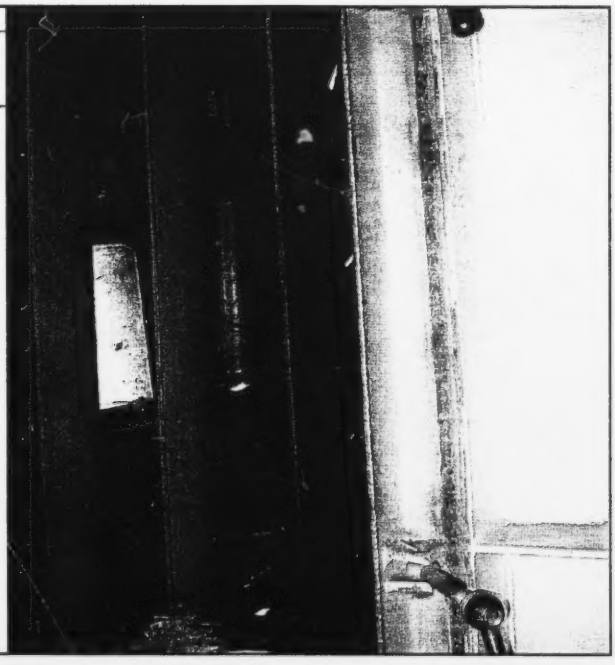
36 MWe Plant in Ely, UK uses Method 1





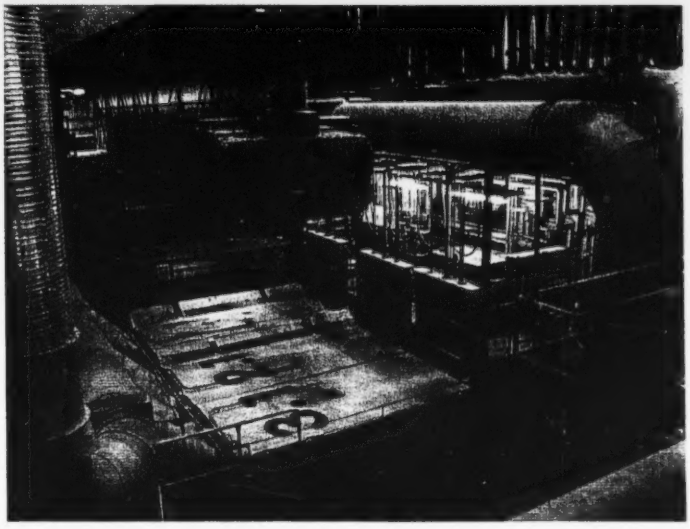


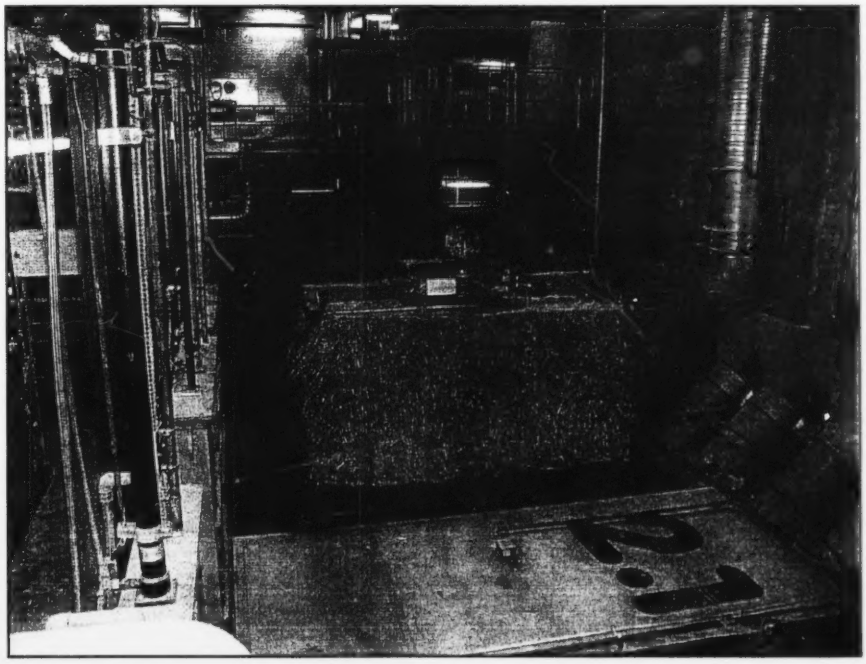
Just before entering furnace bales are shredded



Canada

Maabjerg (DK) Multi-Fuel CHP Plant uses Method 3





CETC CANMET ENERGY TECHNOLOGY CENTRE

Gasification & Pyrolysis: Physical Form

1. Shred bale and feed loose straw
2. Shred bale and shred straw to feed fine particles
3. Feed whole bale (Cigar or "Front Edge" Burning)
4. Pelletize straw and feed pellets

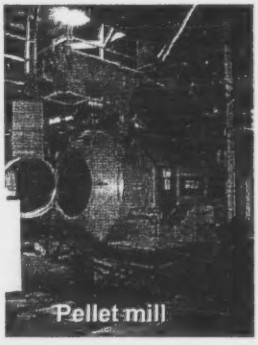
For gasification the residence time/temperature control offered by using pellets (method 4) makes this the preferred option.

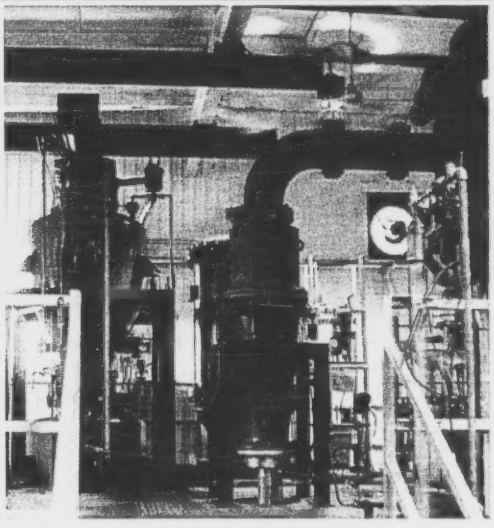
For fast pyrolysis where the particle must be heated to 400 – 500 C in less than one second the use of fine particles (Method 2) is preferred.

Both gasification and pyrolysis require dry material (less than 20% moisture) for optimum yields

CETC CANMET ENERGY TECHNOLOGY CENTRE

Enerkem Fluid Bed Gasifier

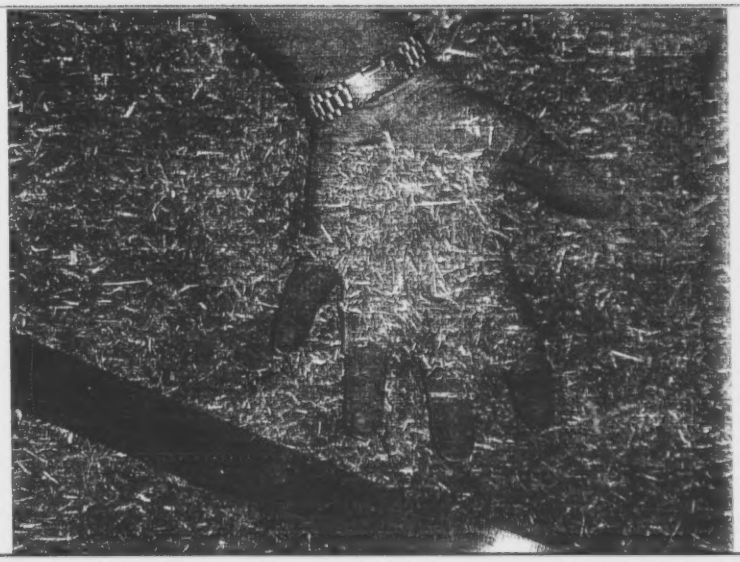

Pellet mill



Canada

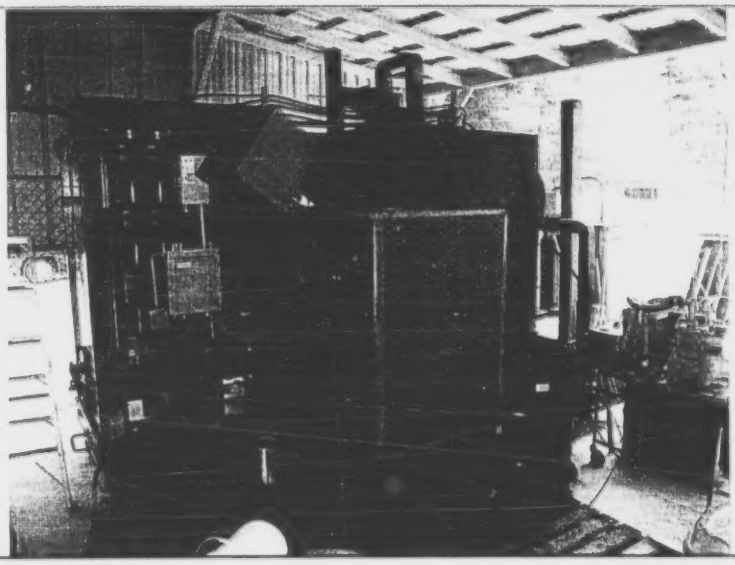
CETC CANMET ENERGY TECHNOLOGY CENTRE

Shredded Straw for Pyrolysis



CETC CANMET ENERGY TECHNOLOGY CENTRE

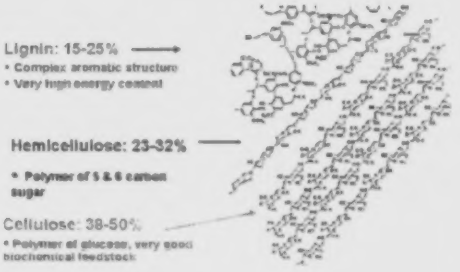
ABRI Portable Pyrolysis Unit



Ligno-cellulosic Composition

Biomass	Lignin	Cellulose	Hemicellulose
Willow	25%	50%	19%
Larch	35%	26%	27%
Straw	14.2%	34%	27.2%

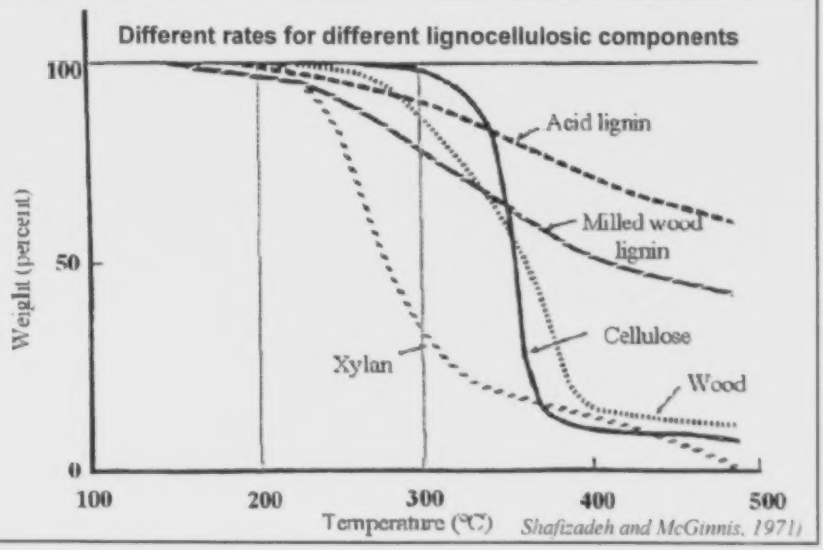
Ligno-cellulosic composition can have a major effect of energy conversion as it affects rates at which the straw material breaks down.



Canada

CETC CANMET ENERGY TECHNOLOGY CENTRE

Thermal Breakdown of Biomass



Shafizadeh and McGinnis, 1971)

CETC CANMET ENERGY TECHNOLOGY CENTRE

Summary

The physical form and ash composition are the key straw properties which must be considered for combustion technologies.

Due to lower operating temperatures, ash concerns are reduced for gasification and pyrolysis processes, however the physical form requirements are more stringent than for combustion systems. In general additional processing such as fine shredding and/or pelletizing may be required.

The lignocellulosic composition of straw will affect the thermal breakdown and hence will influence the gasification and pyrolysis processes. Evaluation of these effects requires further research.

Canada

CETC CANMET ENERGY TECHNOLOGY CENTRE

Thank you

Fernando Preto 613-996-5589 preto@nrcan.gc.ca

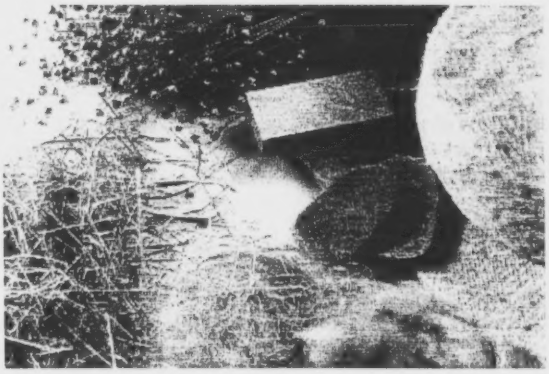


Canada

Building the Flax Straw Value Chain

Presented by
Alvin Ulrich

at
"Whole Crop
Utilization
Workshop"
Innovation Place
March 9, 2006



A value chain can have many links, with each link having activities and results that affect neighboring links and the whole chain



What limits the length of a value chain?



The potential built by each link!

What limits the strength of a value chain?



Weak Link

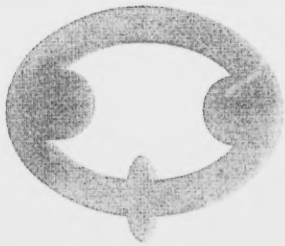
A value detracting activity!

What limits the worth of a value chain?

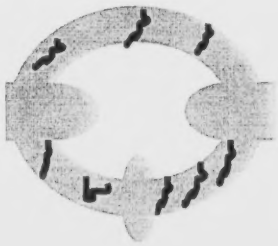


The sum total of each of its links!

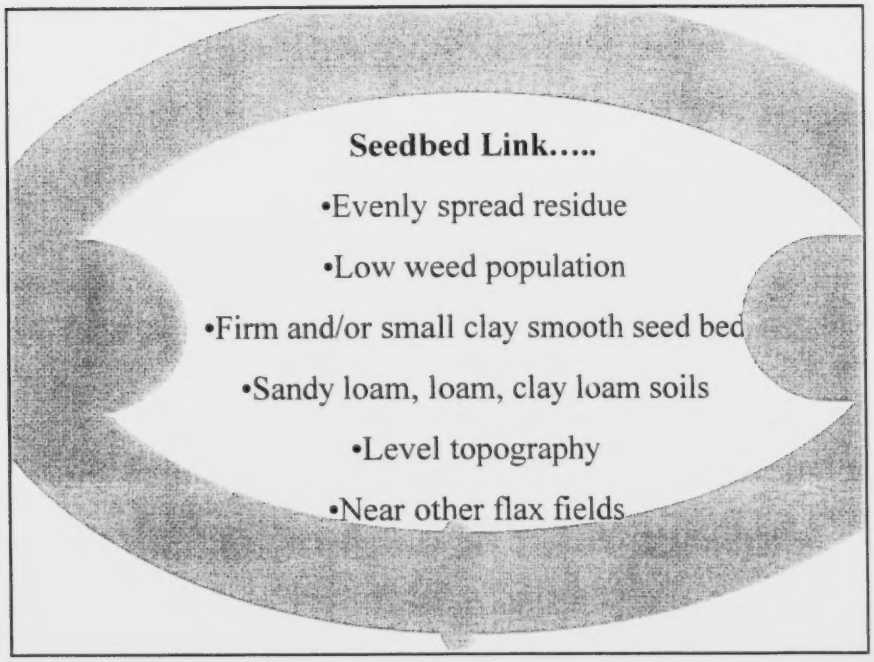
longer and stronger = more value

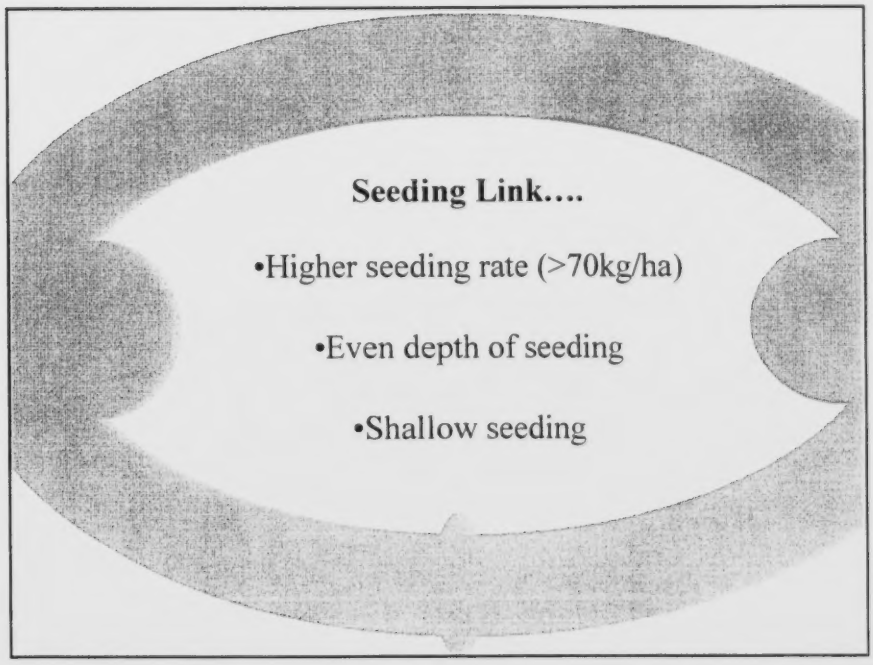


= Strong link



= Weak link


Seedbed Link…..
•Evenly spread residue
•Low weed population
•Firm and/or small clay smooth seed bed
•Sandy loam, loam, clay loam soils
•Level topography
•Near other flax fields

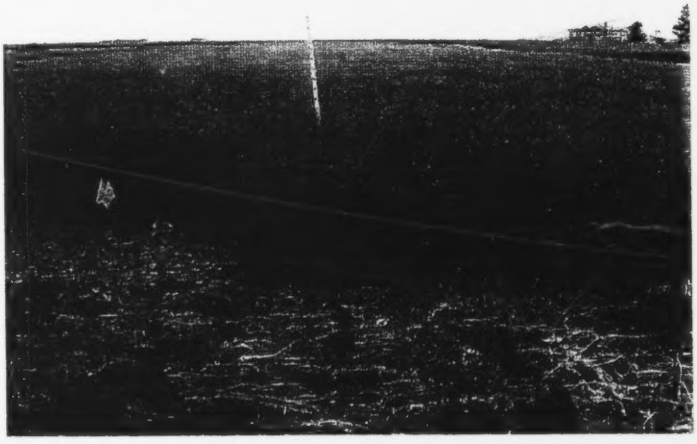

Seeding Link….
•Higher seeding rate (>70kg/ha)
•Even depth of seeding
•Shallow seeding



Good



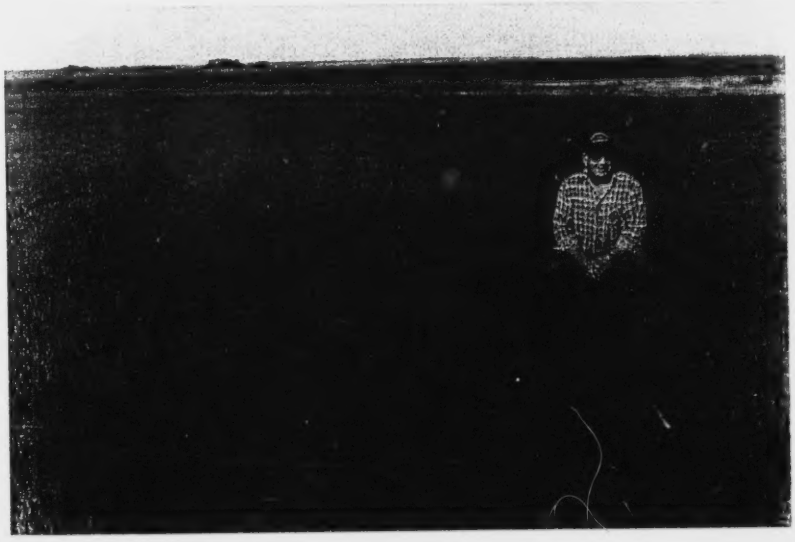
Good



….Seeding Link

- Wide "ribbon" seed placement
- Higher fiber content varieties
- Taller straw varieties



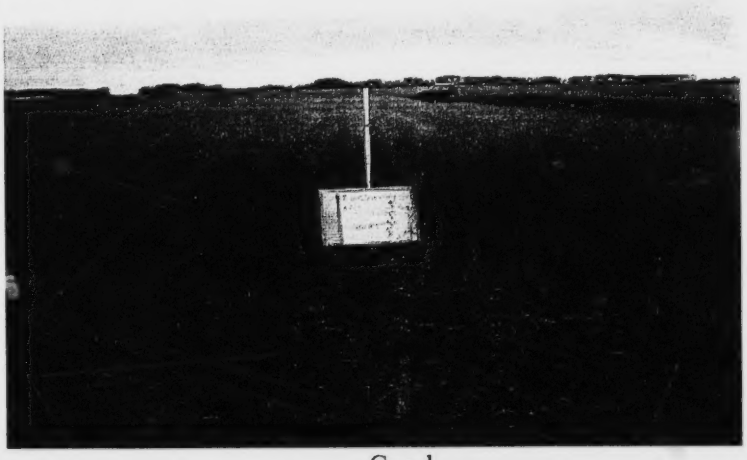


Growing Season Link….

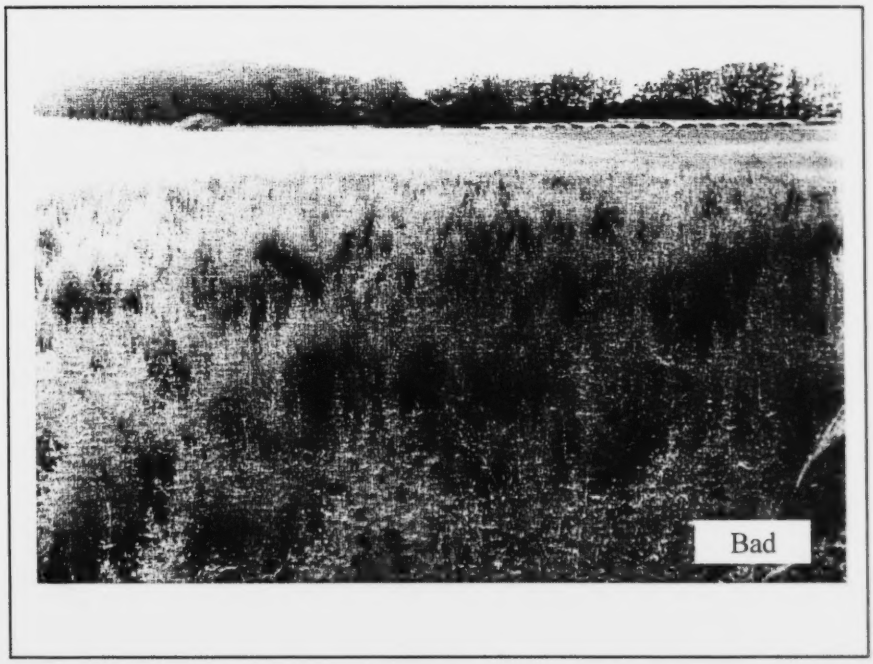
•Good weed control

•No herbicide damage

•Moderate weather conditions



Good



Harvest Link….

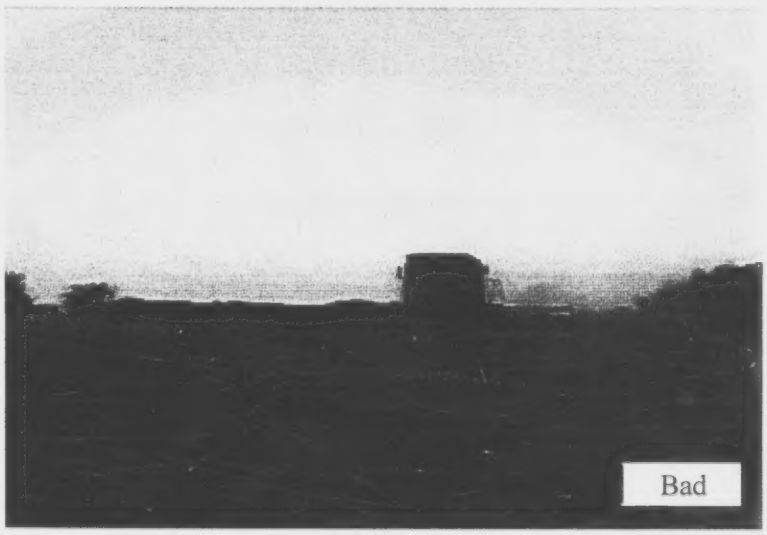
- Tall plants
- High fiber content straw
- No weed infestation
- No plastic and other litter

....Harvest Link

•Straw not put through combine

•No seedholders mixed with straw

•Straw in thin even layer touching ground

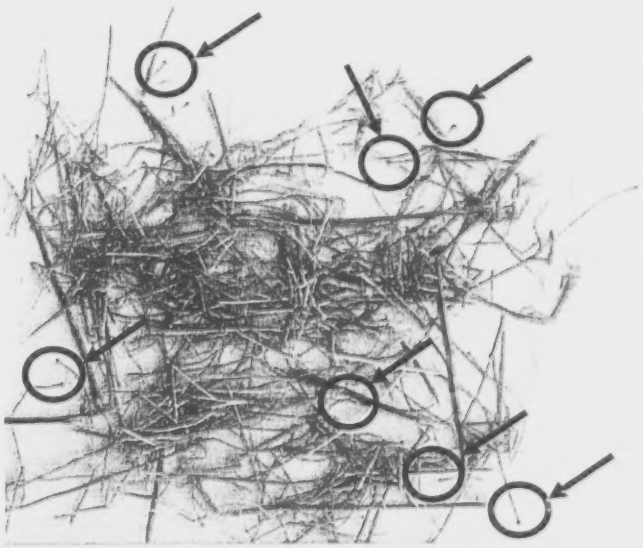


Don't Want....

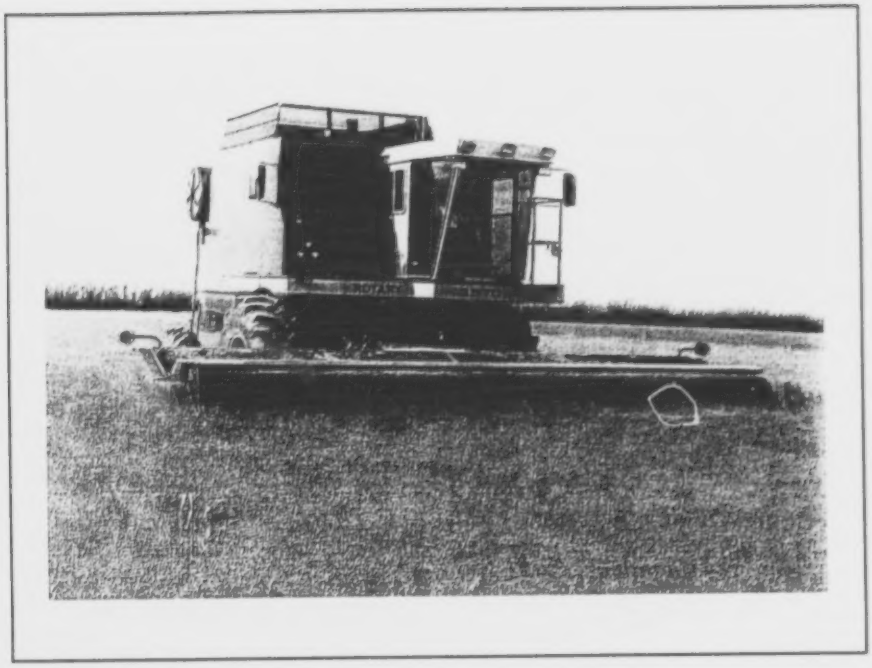


Badly broken, <u>unretted</u> straw with seed holders mixed in the straw

Don't Want...

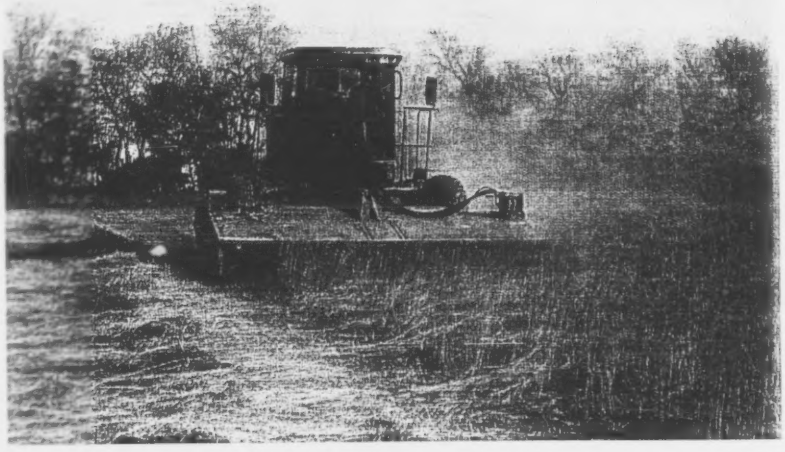


Seed Holders





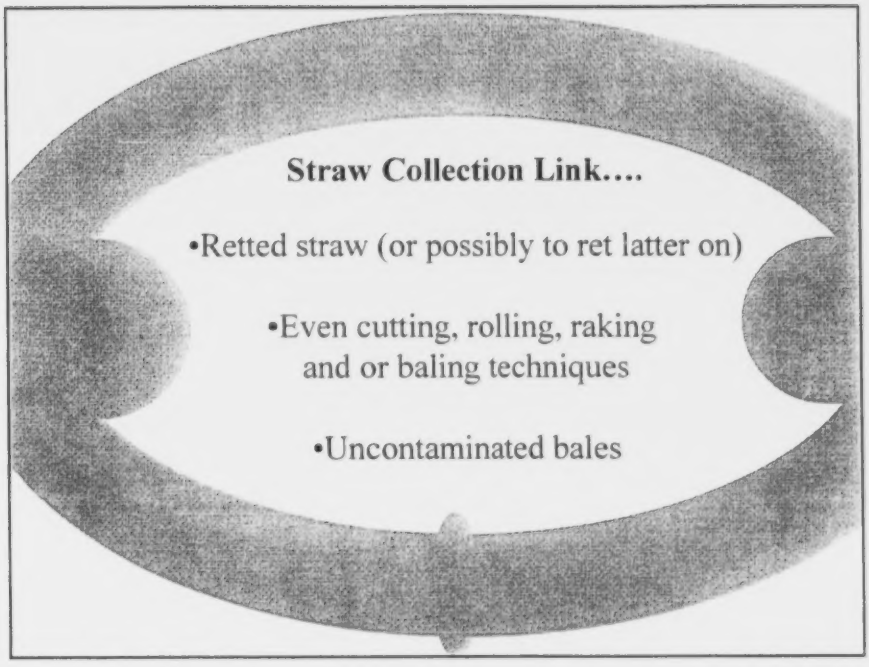


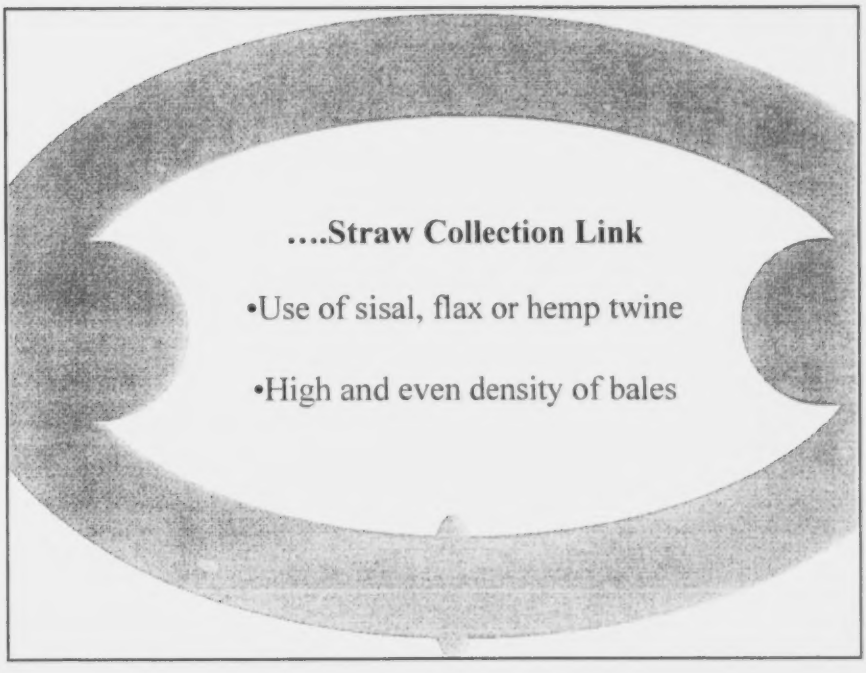




Good

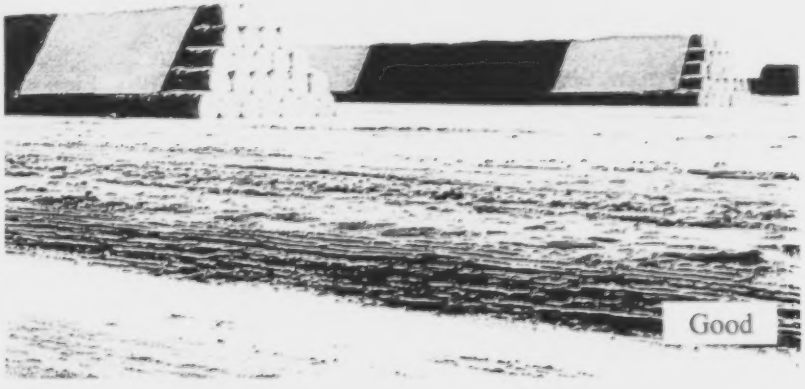


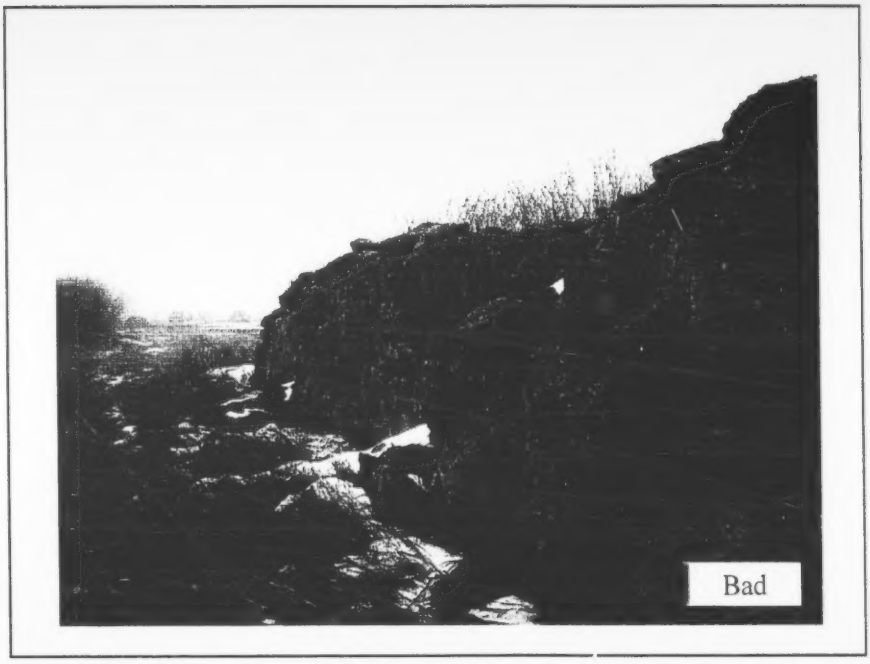

Straw Collection Link....
•Retted straw (or possibly to ret latter on)
•Even cutting, rolling, raking and or baling techniques
•Uncontaminated bales

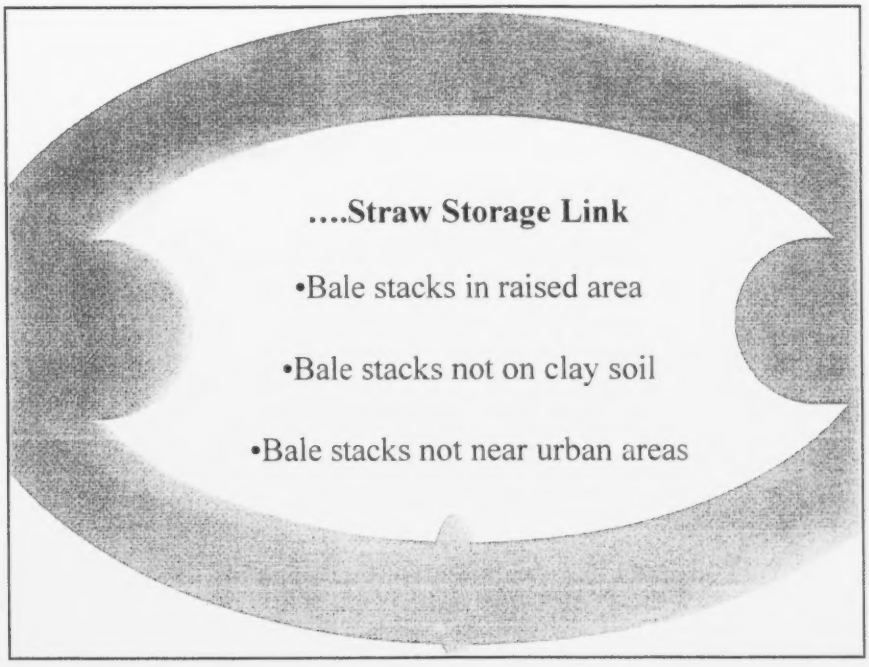

....Straw Collection Link
•Use of sisal, flax or hemp twine
•High and even density of bales

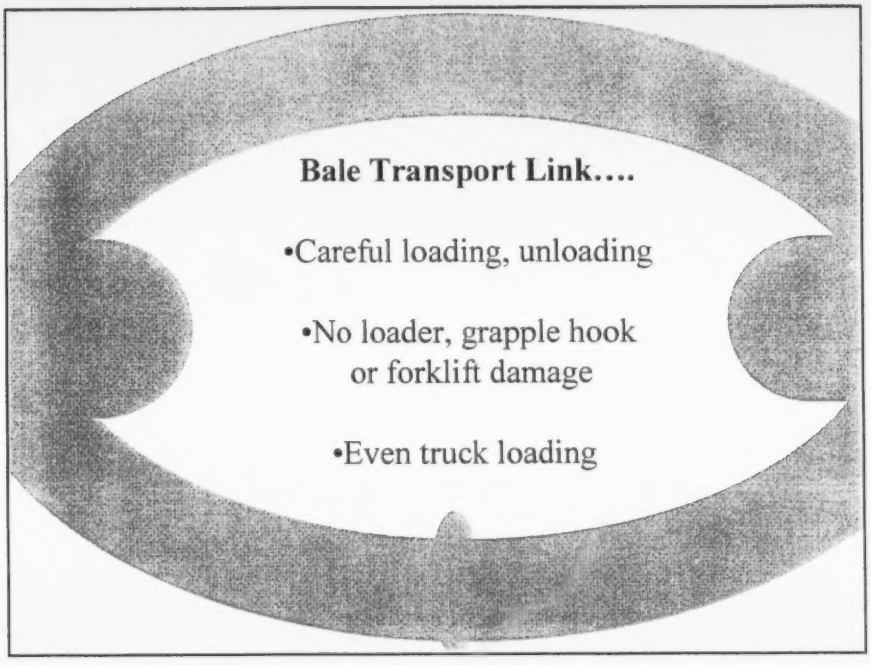
Straw Storage Link....

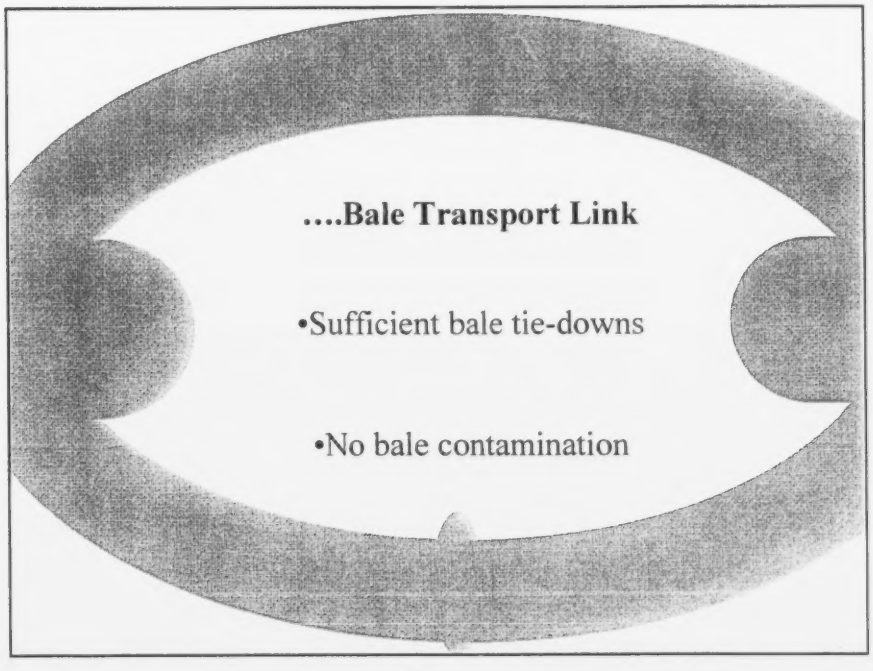
- Bales stacked loosely
- Bales stacked indirectly on ground
- Bale stacks with sloped waterproof cover
- Bale stacks widely separated(fire)




Bad


....Straw Storage Link
•Bale stacks in raised area
•Bale stacks not on clay soil
•Bale stacks not near urban areas

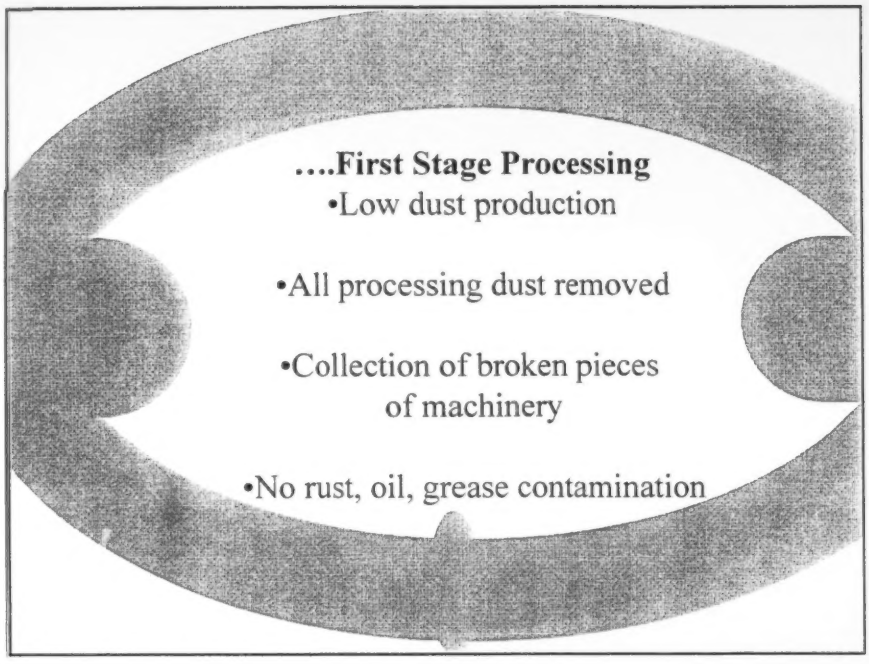

Bale Transport Link....
•Careful loading, unloading
•No loader, grapple hook or forklift damage
•Even truck loading

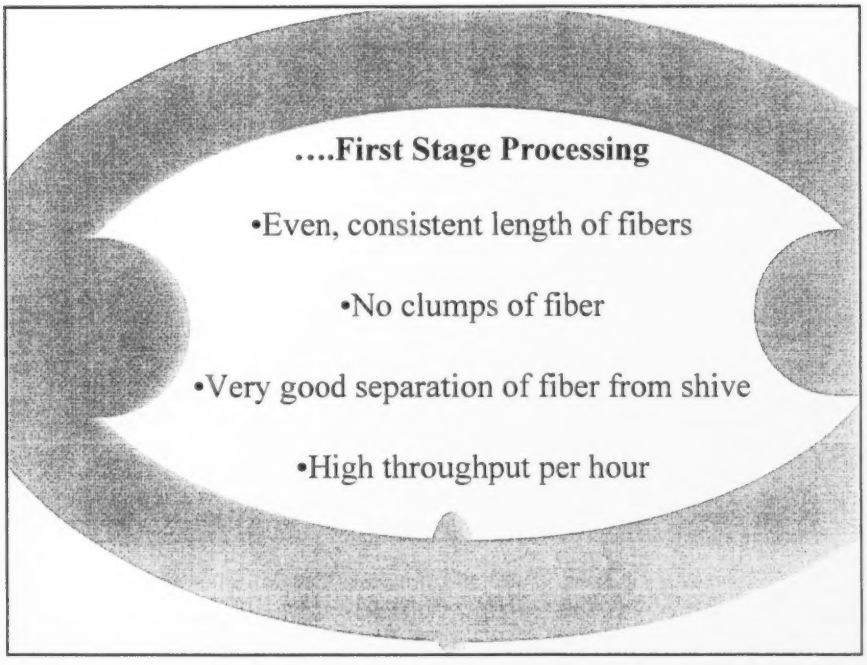

....Bale Transport Link
•Sufficient bale tie-downs
•No bale contamination

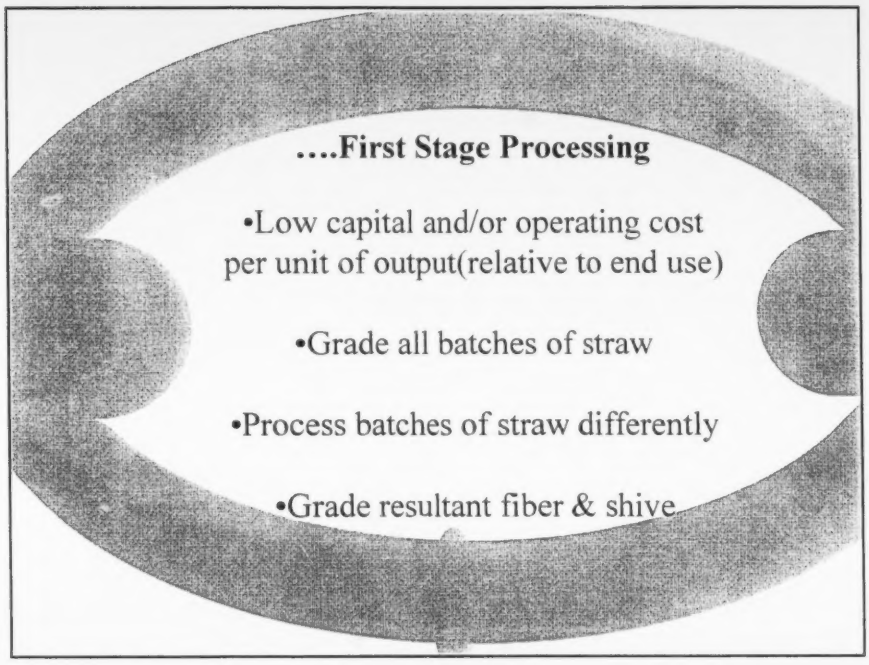
First Stage Processing....

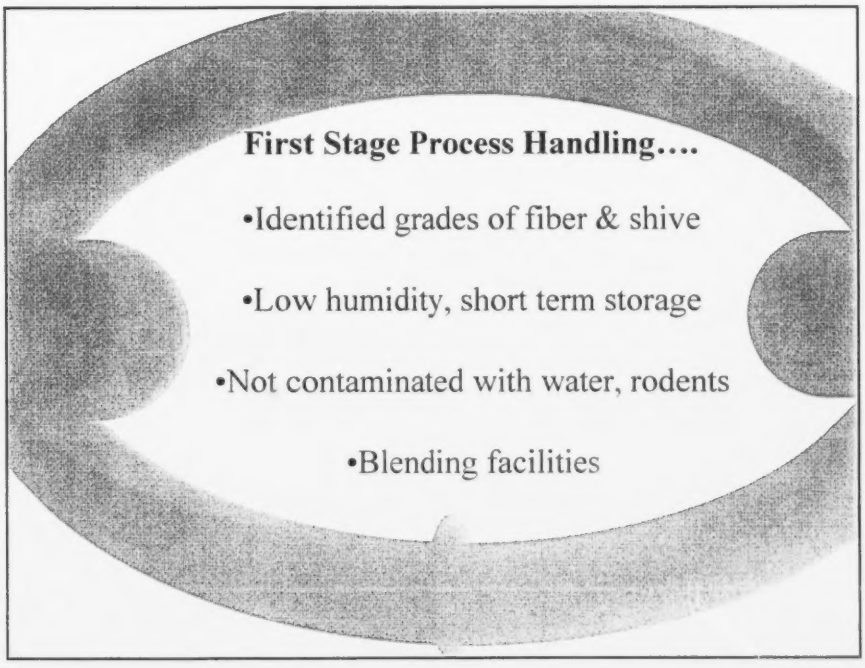
- Optimum(<14%;>8%) moisture straw
- Consistent moisture content straw
- Stone and dirt lump traps
- Sequential gentle decortication

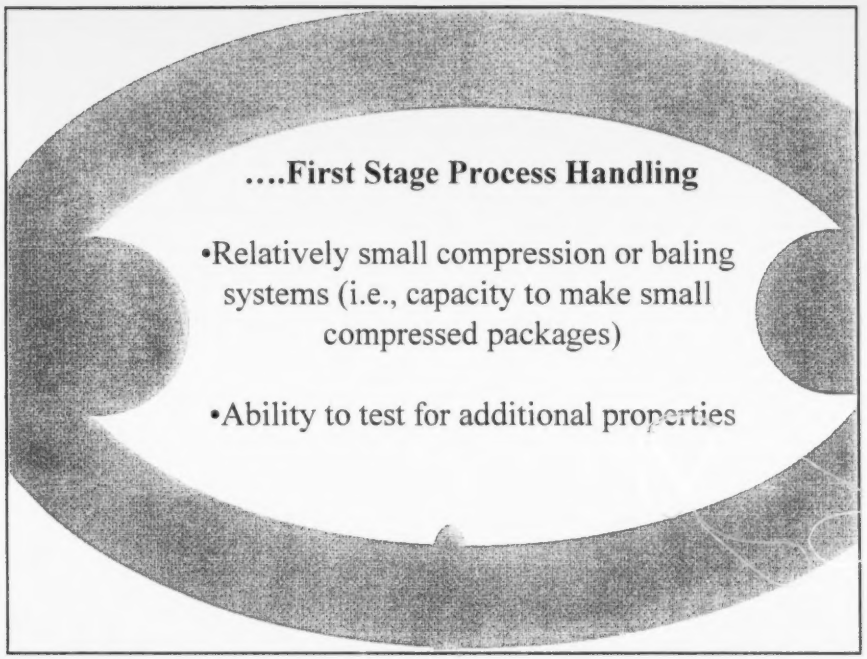


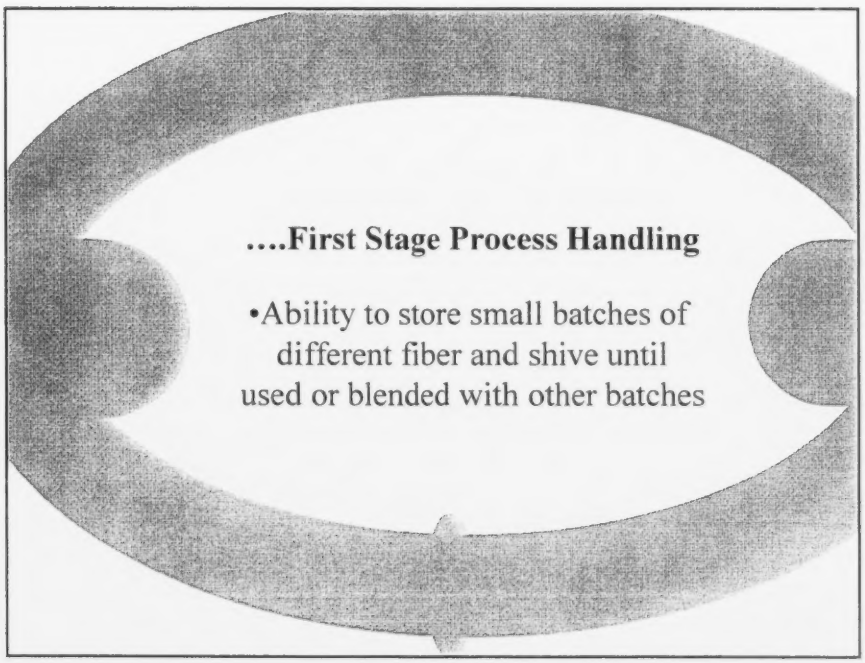

....First Stage Processing
•Low dust production
•All processing dust removed
•Collection of broken pieces of machinery
•No rust, oil, grease contamination


....First Stage Processing
•Even, consistent length of fibers
•No clumps of fiber
•Very good separation of fiber from shive
•High throughput per hour


....First Stage Processing
•Low capital and/or operating cost per unit of output(relative to end use)
•Grade all batches of straw
•Process batches of straw differently
•Grade resultant fiber & shive


First Stage Process Handling....
•Identified grades of fiber & shive
•Low humidity, short term storage
•Not contaminated with water, rodents
•Blending facilities


....First Stage Process Handling
•Relatively small compression or baling systems (i.e., capacity to make small compressed packages)
•Ability to test for additional properties


....First Stage Process Handling
•Ability to store small batches of different fiber and shive until used or blended with other batches



Straw and
Shive Bales
in
Warehouse

Warning

Links in Value Chains
Break when the Benefit
Received is Less than the Cost

Any Questions?

Contact:
Alvin Ulrich

Biolin Research
161 Jessop Avenue
Saskatoon S7N 1Y3

Tel: 306.668.0130
Fax: 306.668.0131

aulrich@biolin.sk.ca



Whole Crop Utilization Workshop



1

Schweitzer-Mauduit International

- Schweitzer-Mauduit International is a diversified producer of premium specialty papers and the world's largest supplier of fine papers to the tobacco industry. Schweitzer-Mauduit conducts business in over 90 countries and employs approximately 3,800 people worldwide, with operations in the United States, France, Brazil, Indonesia, the Philippines and Canada.
- Schweitzer-Mauduit is listed on the NYSE under the symbol SWM and has annual sales of more than $650 million dollars US.

2

Schweitzer-Mauduit Canada Inc.

- Schweitzer-Mauduit Canada Inc.is headquartered in Winkler, MB where it maintains office, fleet & fabricating shops and warehouse facilities.
- Fibre manufacturing facilities consist of a recently completed fixed decorticating plant located in Carman, MB. The company also employs a portable processing mill which operates from straw yards in Souris, Pilot Mound and Treherne, MB.
- Additional flax tow warehouse storage is located in Glenboro and Killarney, MB.

3

Schweitzer-Mauduit Canada Inc.

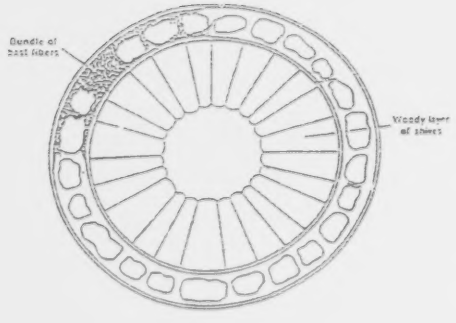
- Fibre operations has 50 full time employees and adds another 25 seasonal people during the straw purchasing season.
- Over 200 independent operators are involved in straw purchasing on a seasonal basis, baling, trucking, stacking and covering.
- SWM purchases over 200,000 acres each fall from buying areas in Manitoba, Saskatchewan and North Dakota involving more than 1,000 producers.

4

Flax Plant

- Two primary components
- Bast fiber – around circumference of the plant stem
  - Approximately 20% of plant
- Shive – core of plant
  - Approximately 80% of plant
- Tow – Used for paper making is a mixture of bast and shive
  - Approximately 2/3 bast and 1/3 shive

5



SCHEMATIC SECTION THROUGH A FLAX STEM

BAST = 20% of Stem

SHIVE = 80% of Stem

TOW = MIXTURE OF BAST AND SHIVE

6

Flax Crop

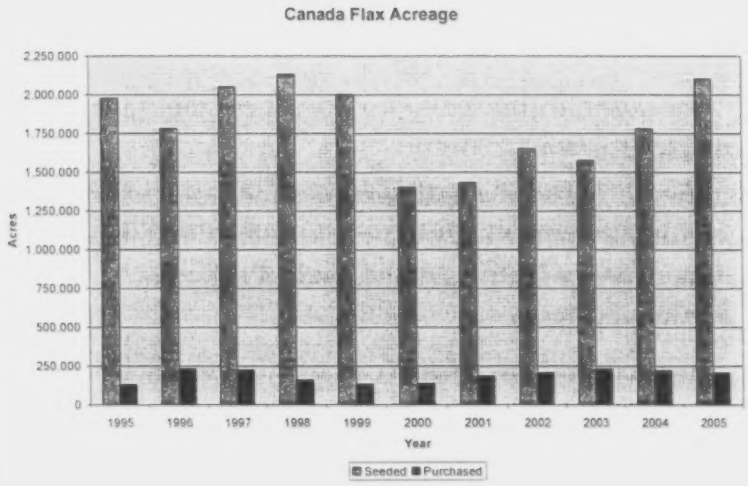
- Planting occurs mid-May to mid-June depending on weather and ground conditions
- Crop matures in approximately 90 - 100 days
- Farmers harvest the crop for the flax seed generally during September into October
- Straw baling occurs after seed is harvested

7

Flax Straw Purchases

- Flax Straw per acre 0.5 to 0.75 tons
  - Average approximately 0.6 tons per acre
- Fiber Operations annual requirements
  - 100,000 to 125,000 tons
  - Equivalent to 200,000 to 250,000 acres
  - Represents approximately 10 to 12 percent of planted acres in Canada.

8



9

Understanding Straw Quality



- Primarily interested in the bast fibre bundles that make up the bark or outside of the flax plant.
- Shive is the inside of the plant and the byproduct of production.
- Straw retting is largest single factor in determining straw quality as it relates to processing.

10

Straw Quality

- Straw must be allowed to lay for a period of time in order to achieve this.
- Retting is bacterial degradation of the straw which occurs best under warm moist weather conditions.
- The degree of rett is determined by the colour change in straw.
- Straw that has progressed in conditioning to the gray stage is most suitable for baling.
- Flax straw that is green or yellow cannot be properly processed.

11

Straw Quality

- Well retted straw decorticates easily and improves production rate and yields.
- Straw length is also a contributing factor.
- Tall straw is not only more economical to bale, it reduces the boll fraction of the plant which improves fibre yield.
- Stubble should be no more than 4 to 6 inches.
- Fields must be clean and weed free.
- Fields must also be contamination free of ploy twine, plastic, rubber and other garbage.

12

Straw Purchasing Program

- Field Supervisors monitor crop from planting in May – June through maturity in September
- Potential survey of crop, late August.
  - Growing region divided into separate areas of 500 to 1,500 square miles
  - Each area is surveyed for:
    - Total flax acreage
    - Flax acreage density

13

Straw Purchasing Program

- Crop height by field
- Plant density
- Weed infestation
- Plant maturity by field
- Moisture conditions

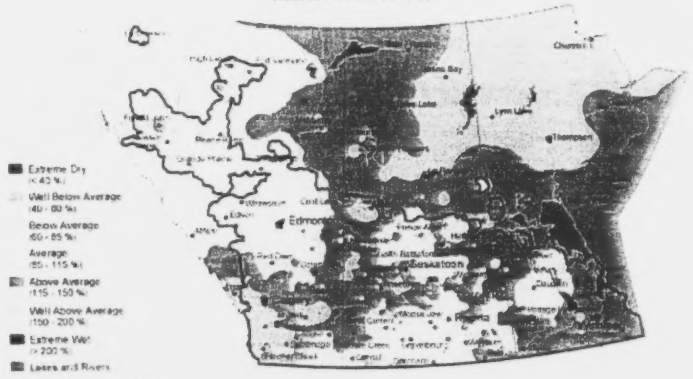
- The above information is entered into a data base that calculates estimated straw yield per acre and usable tonnage potential for each individual area

14

Percent of Average Precipitation

April 1, 2005 to August 31, 2005

(Updated November 25, 2005)



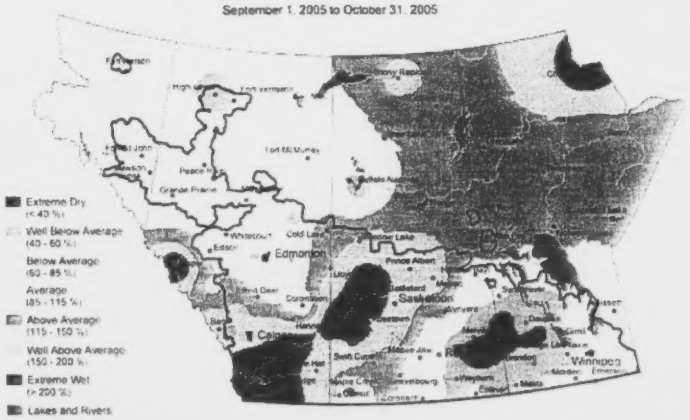
www.agr.gc.ca/pfra/drought

This updated end of Growing Season map is prepared by Agriculture and Agri-Food Canada (PFRA-NAIS) and is produced with data received by: Alberta Agriculture, Food and Rural Development (AAF RD) in cooperation with Alberta Environment, Alberta Financial Services Corporation (AFSC), Farmer Independent Weekly, Saskatchewan Agriculture and Food (SAF), Saskatchewan Crop Insurance Corporation (SCIC) in cooperation with: Ag Financial Ltd, Saskatchewan Forestry (SEFBM) and the Timely Climate Monitoring Network (TCMN).

15

Percent of Average Precipitation

September 1, 2005 to October 31, 2005



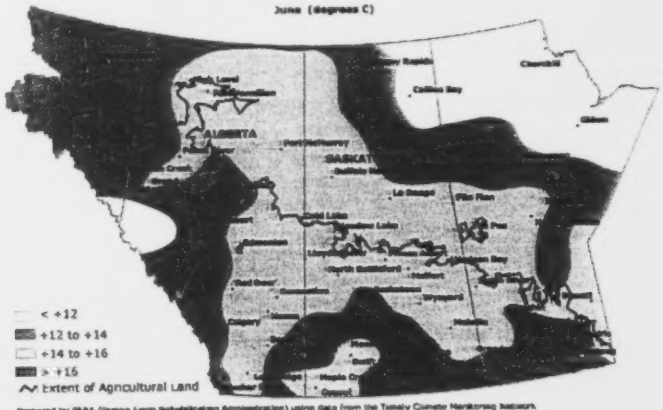
www.agr.gc.ca/pfra/drought

Prepared by Agriculture and Agri-Food Canada (PFRA) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

16

Normal Monthly Mean Temperature

June (degrees C)



Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Totally Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

17

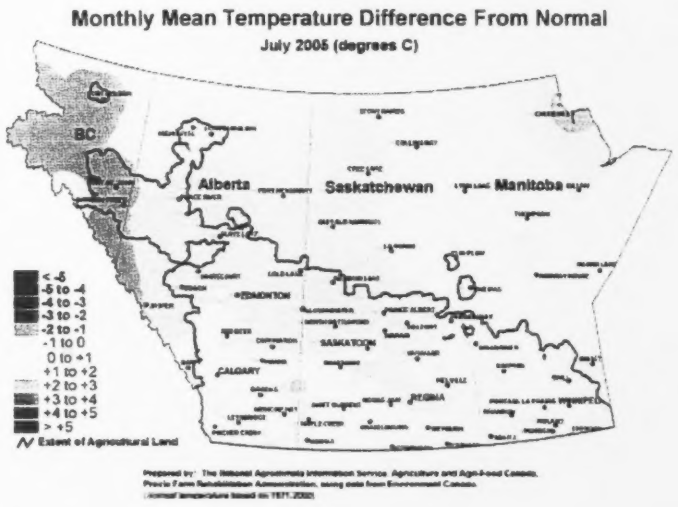
Monthly Mean Temperature Difference From Normal

June 2005 (degrees C)



Prepared by: The National Agroclimate Information Service, Agriculture and Agri-Food Canada
Prairie Farm Rehabilitation Administration, using data from Environment Canada
(Normal temperatures based on 1971-2000)

18



19

Straw Purchasing Program

- The total potential tonnage is totaled from all areas surveyed.
- Spotswood provides tow requirements for next year.
- Straw purchase requirements to meet tow requirements are calculated.
- Management authorizes straw purchase volume.

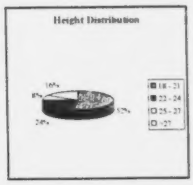
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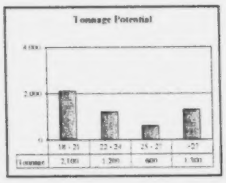
Survey Location	**Treherne**	Supv:	Donn Kravnick
Survey Date	26-Aug	Buyer	Garry McMannis
Harvest Date	########	Equip	adequate
Area Size (Sq Mi)	460	Moist	adequate
2003 Flax Acres	13,524	% Norm	100%
Percent Change	-30%		
2004 Flax Acres	9,467	Acres / Sq Mi	21

Comments:

My earliest area. Area continues to experience a large decrease in flax acreage,another 30% again this year. Overall increased plant density and height will help Garry obtain quota of 5500 tons,weather permitting.

Height	< 18	18 - 21	22 - 24	25 - 27	>27	Total
% of Total Acres	0%	52%	24%	8%	16%	**100%**
Acres	0	5,000	2,200	800	1,500	**9,500**
Percent Weeds		12%	0%	0%	0%	**6%**
Useable Acres		4,400	2,200	800	1,500	**8,900**
Average Height		20.0	22.0	26.0	29.0	**22.5**
Average Yield		0.47	0.56	0.75	0.88	**0.59**
Estimated Tons		2,100	1,200	600	1,300	**5,200**
Thin Stand		0%	0%	0%	0%	**0%**
Fair Stand		12%	0%	0%	0%	**6%**
Good Stand		88%	100%	0%	0%	**70%**
Exec Stand		0%	0%	100%	100%	**24%**
Percent Blooming		1%	4%	2%	4%	**2%**
Percent Bolled		99%	96%	98%	96%	**98%**





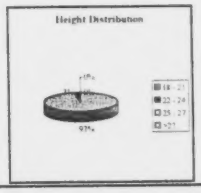
21

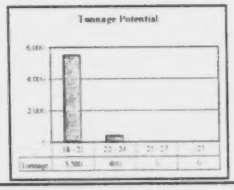
Survey Location	**Treherne**	Supv:	Donn Kravnick
Survey Date	08/20/02	Buyer	John Rankin
Harvest Date	10-Sep	Equip	Adequate
Area Size (Sq Mi)	576	Moist	Adequate
2001 Flax Acres	22,979	% Norm	
Percent Change	-5%		
2002 Flax Acres	24,128	Acres / Sq Mi	42

Comments:

The prolonged heat in July/August has affected this area the most. Fields were in full bloom during the heat spell. What looked like a potentially good area is below average now. However, John felt he could achieve his tonnage.

Height	< 18	18 - 21	22 - 24	25 - 27	>27	Total
% of Total Acres		97%	3%	0%	0%	**100%**
Acres		23,400	700	0	0	**24,100**
Percent Weeds		43%	0%	0%	0%	**41%**
Useable Acres		13,400	700	0	0	**14,100**
Average Height		18.6	23.0	25.0	28.0	**18.8**
Average Yield		0.41	0.61	0.70	0.84	**0.42**
Estimated Tons		5,500	400	0	0	**5,900**
Thin Stand		0%	0%	0%	0%	**0%**
Fair Stand		60%	0%	0%	0%	**59%**
Good Stand		33%	100%	0%	0%	**35%**
Exec Stand		0%	0%	100%	100%	**0%**
Percent Blooming		1%	1%	0%	0%	**1%**
Percent Bolled		99%	99%	100%	100%	**99%**





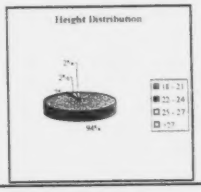
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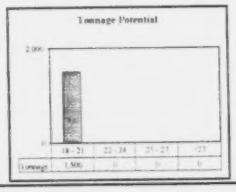
Survey Location:	**Domain**	Supv:	Herb Nelson
Survey Date:	Aug 10/05	Buyer:	Abe Neufeld
Harvest Date:	Sept 1/05	Equip:	Adequate
Area Size: (Sq. Mi.)	1350	Moist:	Above average
2004 Flax Acres:	29,000	% Norm:	150%
Percent Change:	-50%		
2005 Flax Acres:	14,500	Acres / Sq. Mi:	11

Comments:

There is very little useable flax in this area. Most flax was not seeded and the fields that are there are short and dirty and very thin. We have only formd 3 good fields so far. I don't think we should have a buyer working in this area.

Height	< 18	18 - 21	22 - 24	25 - 27	>27	Total
% of Total Acres:	55%	42%	1%	1%	1%	**100%**
Acres:	8,000	6,100	100	100	100	**14,400**
Percent Weeds:		40%	100%	100%	100%	**44%**
Useable Acres:		3,600	0	0	0	**3,600**
Average Height:		18.5	22.0	25.0	28.0	**18.5**
Average Yield:		0.40	0.56	0.70	0.84	**0.40**
Estimated Tons:		1,500	0	0	0	**1,500**
Thin Stand:		0%	100%	100%	100%	**6%**
Fair Stand:		68%	0%	0%	0%	**64%**
Good Stand:		32%	0%	0%	0%	**30%**
Exec Stand:		0%	0%	0%	0%	**0%**
Percent Blooming:		0%	0%	0%	0%	**0%**
Percent Bolled:		100%	100%	100%	100%	**100%**





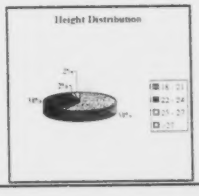
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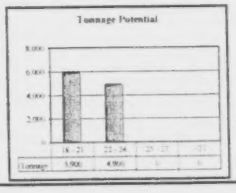
Survey Location:	**Domain**	Supv:	Herb Nelson
Survey Date:	Aug 20/03	Buyer:	Abe Neufeld
Harvest Date:	Aug 15/03	Equip:	Adequate
Area Size: (Sq. Mi.)	1350	Moist:	Below Avg
2002 Flax Acres:	32,000	% Norm:	
Percent Change:	0%		
2003 Flax Acres:	32,000	Acres / Sq. Mi:	24

Comments:

Early crops have poor conditioning, rain has helped and will start baling Aug 25. The later combined fields are looking better but rain is needed. Lots of fields will be rejected for weeds and unconditioned.

Height	< 18	18 - 21	22 - 24	25 - 27	>27	Total
% of Total Acres:		58%	38%	2%	2%	**100%**
Acres:		18,400	12,200	700	700	**32,000**
Percent Weeds:		26%	31%	100%	100%	**31%**
Useable Acres:		13,700	8,400	0	0	**22,100**
Average Height:		19.1	22.4	25.0	28.0	**20.3**
Average Yield:		0.43	0.58	0.70	0.84	**0.49**
Estimated Tons:		5,900	4,900	0	0	**10,800**
Thin Stand:		0%	0%	0%	0%	**0%**
Fair Stand:		22%	18%	100%	100%	**24%**
Good Stand:		78%	82%	0%	0%	**76%**
Exec Stand:		0%	0%	0%	0%	**0%**
Percent Blooming:		0%	0%	0%	0%	**0%**
Percent Bolled:		100%	100%	100%	100%	**100%**





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Straw Purchasing Program

- Seasonal buyers, local retired farmers, are hired.
- 3 to 5 buyers are assigned to each of the 5 Field Supervisors for specific areas.
- Quota acreages are assigned to each buyer within the potential tonnage for their area.
- Fields are "booked" for potential purchase.

25

Straw Purchasing Program

- Field Identification
  - Each field assigned a unique number
  - Data entered for each field into database
    - Owner
    - Location
    - Acres
    - Height
- Potential tonnage calculated by field, by area and in total.

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Straw Purchase Program

- Actual field data entered when straw is delivered to storage yard
  - Tons of straw
  - Yield – tons per acre
- Inventory data base maintains location of field by stack number in storage yard
- Traceability of straw in storage stack back to field it was purchased from is maintained

27

Contamination Alert

- Paper mill alerted of all contamination
  - Notified by lot number
  - Type of contamination identified
  - Sample of contamination kept on file for future reference

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Contamination Reduction

- Data base developed to log all contamination found in tow bales
  - Identified by storage yard and stack numbers
    - Field (10 to 20 per stack)
    - Baler
    - Trucker
    - Seasonal straw buyer

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Ongoing Program

- Continuous analysis of data base from alert investigations and follow-up on suspect suppliers and fields.
- Restricted buying area books updated as required Alert list developed for seasonal straw buyers.
- Determine appropriate changes in straw purchasing procedures.

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Flax Straw Quality Projects



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Flax Fibre Study

- Fibre study undertaken to determine the fibre content of different flax varieties.
- Will use newly developed NIR technology to determine the fibre content of selected samples.
- Study will identify high fibre content varieties to aid plant breeders in developing enhanced fibre content varieties.

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NIR Fiber %

Raw Data

	Brandon	Melfort	Rosebank	Souris	Variety Average
CDC Bethune	18.5%	17.6%	16.8%	14.2%	**16.8%**
Flanders	20.5%	17.7%	19.3%	16.0%	**18.4%**
FP 2136	17.2%	17.6%	18.2%	13.9%	**16.7%**
FP 2141	18.6%	17.0%	17.3%	15.6%	**16.4%**
FP 2142	17.5%	17.8%	19.1%	15.0%	**17.6%**
FP 2159	20.5%	16.5%	16.6%	14.3%	**16.2%**
FP 2161	23.6%	17.5%	18.3%	15.3%	**17.6%**
FP 2162	18.7%	19.1%	20.8%	17.1%	**20.1%**
FP 2182	16.8%	17.5%	17.5%	14.4%	**17.1%**
FP 2183	17.5%	15.6%	15.9%	12.0%	**15.1%**
FP 2184	16.1%	16.5%	18.3%	13.7%	**16.5%**
FP 2185	14.6%	17.9%	18.2%	13.9%	**16.5%**
FP 2186	17.5%	15.4%	13.3%	11.9%	**13.8%**
FP 2187	17.4%	18.1%	18.9%	14.0%	**17.1%**
FP 2188	16.5%	17.1%	18.3%	14.2%	**16.8%**
FP 2189	17.9%	17.2%	17.5%	13.6%	**16.2%**
FP 2190	19.1%	16.9%	18.2%	16.0%	**17.3%**
FP 2191	16.3%	17.9%	19.4%	14.6%	**17.8%**
FP 2192	16.7%	17.6%	17.4%	11.7%	**15.8%**
FP 2193	18.0%	17.4%	19.3%	14.1%	**16.9%**
FP 2194	18.1%	17.3%	20.3%	14.8%	**17.6%**
FP 2195	17.2%	16.5%	18.2%	13.1%	**16.5%**
FP 2196	15.2%	17.7%	17.8%	15.3%	**17.0%**
FP 2197	17.1%	16.4%	18.2%	15.9%	**16.4%**
FP2137	15.8%	18.3%	17.7%	12.2%	**16.3%**
Field Average (%)	**17.7%**	**17.3%**	**18.0%**	**14.3%**	**16.8%**

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Indexed on CDC Bethune

	Brandon	Melfort	Roseban k	Souris	Variety Average
CDC Bethune	100	100	100	100	**100**
Flanders	111	100	115	112	**110**
FP 2136	93	100	109	98	**100**
FP 2141	100	97	103	110	**98**
FP 2142	95	101	114	105	**105**
FP 2159	111	94	99	100	**97**
FP 2161	127	99	109	107	**105**
FP 2162	101	108	124	120	**120**
FP 2182	91	100	105	101	**102**
FP 2183	94	89	95	84	**90**
FP 2184	87	94	109	96	**98**
FP 2185	79	102	108	98	**98**
FP 2186	95	88	79	83	**82**
FP 2187	94	103	112	99	**102**
FP 2188	89	97	109	100	**100**
FP 2189	96	98	104	96	**97**
FP 2190	103	96	109	113	**103**
FP 2191	88	102	116	103	**106**
FP 2192	90	100	104	82	**94**
FP 2193	97	99	115	99	**101**
FP 2194	98	98	121	104	**105**
FP 2195	93	94	108	92	**98**
FP 2196	82	101	106	108	**101**
FP 2197	92	93	109	111	**98**
FP2137	85	104	105	86	**97**

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Flax Fibre Study

- Initial testing results indicate that there are varieties - short or tall - with little variability in height.
- The % of fibre content is high in some varieties (20%) with little variation and consistently low (9.5%) in others.
- There are varieties producing higher fibre yield (kg/ha) than others.

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NIR Fiber %				
	Morden	Rosebank	Souris	Variety Average
Raw Data				
CDC Arras	15.6%	19.4%	13.1%	**16.0%**
CDC Bethune	13.7%	17.9%	14.0%	**15.2%**
CDC Gold	14.8%	20.1%	16.7%	**17.2%**
FP 2102	14.6%	21.5%	14.1%	**15.5%**
FP 2107	13.1%	17.2%	13.7%	**14.7%**
Linola 2047 (SP 2047)	15.2%	14.4%	13.2%	**14.3%**
Linola 2090 (SP 2090)	17.3%	18.6%	15.2%	**16.7%**
Linola 2126 (SP 2126)	10.2%	15.4%	9.7%	**11.3%**
Norlin	12.3%	16.0%	13.1%	**13.8%**
Prairie Blue	15.8%	19.4%	15.8%	**17.0%**
Taurus	13.4%	16.7%	13.9%	**14.8%**
Field Average (%)	**14.1%**	**17.7%**	**13.9%**	**15.1%**

36

Other Fibre & Shive Initiatives

- Due to high energy costs shive is now being given a serious look as a replacement for natural gas in heating applications.
- Vidir Biomass systems has installed a 2 million btu gasifier for heating a chicken barn at Landmark MB which is using two trailers of shive a week.
- Vidir is also building a larger 6 million btu furnace for use with their industrial paint booth in Morris, MB

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Other Fibre & Shive Initiatives

- Vanderveen green houses in Carman, just 4 miles from the PDF mill, are investing $1,000,000 in a shive burning stoker application for heating their recent 100,000 sq. ft.expansion.
- This project could eventually see 10,000 tons of shive used annually to heat this facility.
- Both Vidir and Vanderveen projects could provide the test beds needed for the creation of additional or even larger scale shive burning projects.

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Other Fibre & Shive Initiatives

- KMU Biomass Energy from London ON, a supplier of waste stream gasifier systems to the sawmill and pulp and paper industry has expressed interest in creating a 400 ton/day "green fuel" burning system for the University of Manitoba.
- The university is currently using natural gas and would replace this with a mixture of shive, oat hulls and internal waste to create a fossil fuel free facility.
- This would eliminate their green house gas emissions and place the university on the forefront of environmentally friendly biomass heating technology.

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Other Fibre & Shive Initiatives

- At their request, samples of shive and fibre have been sent to Carbopur a Montreal based carbon filtration company for their evaluation.
- Flax tow bales have been delivered to the USDA flax pilot plant in Clemson, SC to asses the systems capability for cleaning and upgrading this material for possible use in high end applications.
- The Province of MB has expressed an interest in possibly providing funding for this project in order to provide flax fibre to the Composite Innovations Centre at the University of Manitoba.

40

Flax 2015

- Flax 2015 is an initiative funded by Agriculture Canada and the three Prairies provinces which seeks to double the flax acres grown over the next ten years.
- It consists of four pillars or subcommittees, human health, animal health, industrial uses and fibre.
- The committee members have been assigned the task of putting together a strategic plan for research and development to accomplish this goal.

41

Flax 2015

- Flax 2015 has selected to submit as part of the $3.2 million phase 2 funding an extensive investigation into value added opportunities for shive.
- As a commitment to the fibre component of the flax crop. Flax 2015 is seeking funding of toward research into separating, packaging and marketing of shive.
- While energy uses may yield $5 -$15 per ton, it is anticipated that the shive project will look for value added products producing $200 - $250 per ton.

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Flax 2015

- This project seeks industry participation in the form of cash and in kind contributions.
- Areas of research will include screening shive into its constituent parts and product characterization. Development of pilot scale processes capable of being expanding into commercial size ventures.
- Potential product areas will include high end animal bedding, flax flower for composite polymer applications, green building products, filtration and absorbency uses.

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Straw Harvesting Practices

- A project to study the affect that conventional, roto thrash and stripper header harvesting systems have on straw processing and product quality using SWM flax decorticating technology.
- Study headed up by Mark Stumborg, Semiarid Prairie Agricultural Research Center in Swift Current, SK.
- All straw came from the same field, was of the same variety, baled and trucked to our mill at Souris, MB.

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AG Canada Test Loads

Date	Conventional Combine					
12/14/2005	Only put numbers in the cells that are colored					
	Straw	Tow	Yield	Run Time Mins	Hours	Tow Per hour
	11.8	4.66	39.49%	44	0.73	6.35
	Moisture	Shive	Cellulose			
	14.90%	36.30%	55.90%			

Date	Roto Trashed					
12/14/2005	Only put numbers in the cells that are colored					
	Straw	Tow	Yield	Run Time Mins	Hours	Tow Per hour
	12.7	4.46	35.12%	44	0.73	6.08
	Moisture	Shive	Cellulose			
	14.80%	33.50%	55.40%			

Date	Stripper Header					
12/14/2005	Only put numbers in the cells that are colored					
	Straw	Tow	Yield	Run Time Mins	Hours	Tow Per hour
	12.3	3.8365	31.18%	38	0.63	6.06
	Moisture	Shive	Cellulose			
	16.00%	30.10%	58.80%			

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A Good Look at Stripper Headers

Whole Crop Utilization Workshop 2006



Wheatland Conservation Area Inc

Southwest Agri-ARM Site

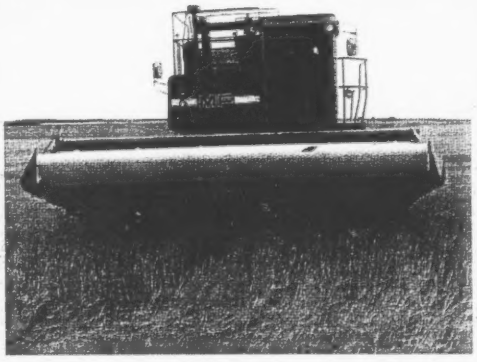
Saskatchewan AgriARM

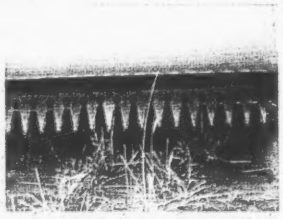
Wheatland Brief History

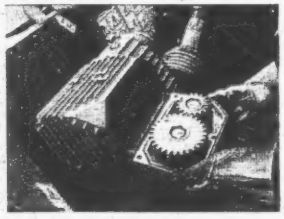
- Non-profit / producer run since 1982.
- Applied research
- Agri-ARM (8 sites)
- Trials
  - -large plots
  - -small plots
  - -demonstrations
  - -business development
  - -industry
  - -extension
- Environmental Farm Plans



A Good Fit for Stripper Headers



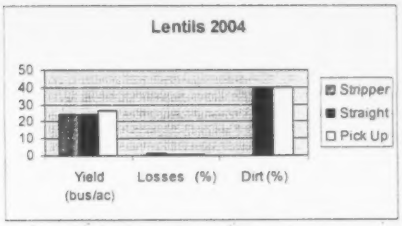




Advantages

- Reduce harvest time.
  -take advantage of optimum harvest window.
  -reduce fuel and labour costs.
- Improve seed quality.
  -mechanical damage, foreign material, colour.
- Minimize harvest losses.
- Leave standing crop residue to be utilized later.

Lentil

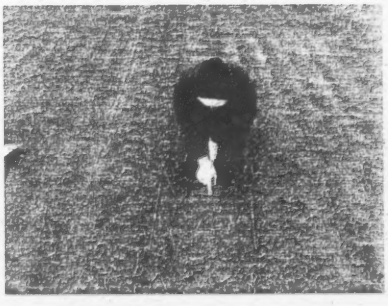








Ground Cover

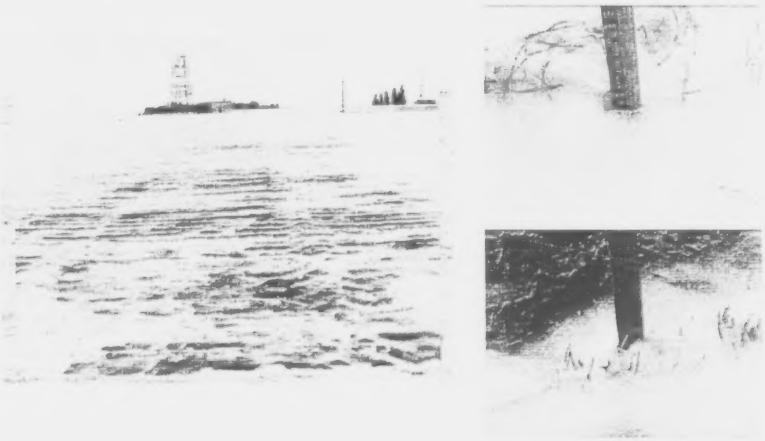


Lentils / Straight Cut



Lentils / Stripper

Groundcover and Snow trapping



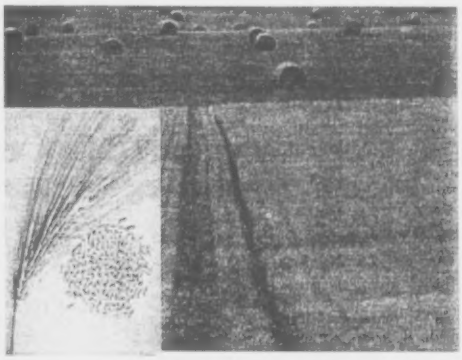
Snow trapping

- Increased snow trapping potential.
- Reduces evapo-transpiration.
- Insulates fall seeded crops.

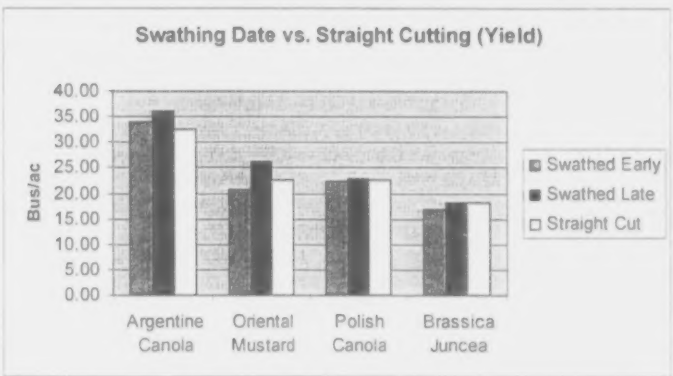


Barley

- Stubble left high
- May need GPS to see where you've been.
- Excellent malt sample.



Oilseeds



There are other disadvantages to swathing.

- Losses from wind.
- Extra operation.
- Can we straight cut? Can we reduce header losses? Is there a better way?





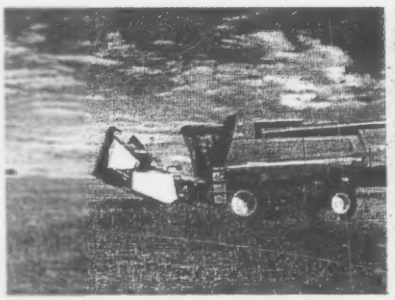
Improved Straight Cutting Techniques in Oilseeds

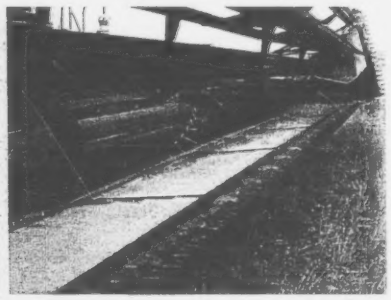
- Can we reduce harvest losses enough to straight cut Argentine canola?

Three headers
-BISO header extension.
-Stripper header.
-Rigid straight cut header.

Three Crops
-Argentine canola
-Oriental Mustard
-Brassica juncea

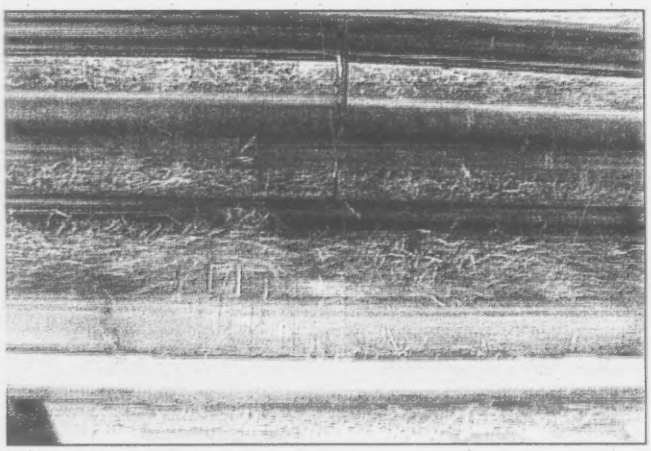
BISO Header Extension





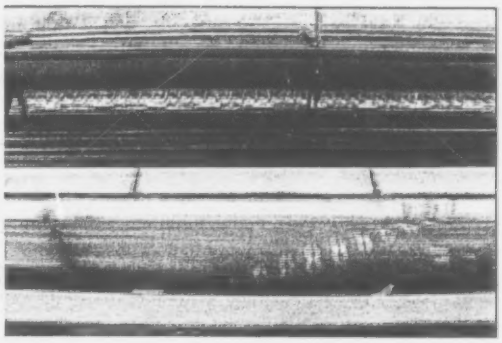
Header from Robert Breckner, Grandview, Manitoba
Combine from Jay Dee Equipment

BISO Header Extension

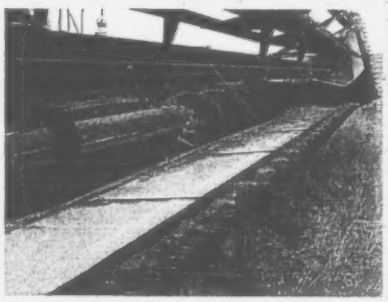


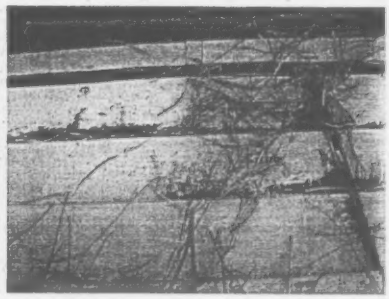
BISO Header

- Reel above plate
- Cutter bar forward
- Crop has no problem feeding
- Seeds caught by ridged plate



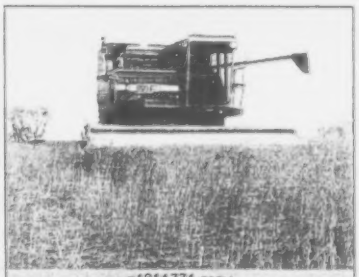
Seed trapped on terraced plate





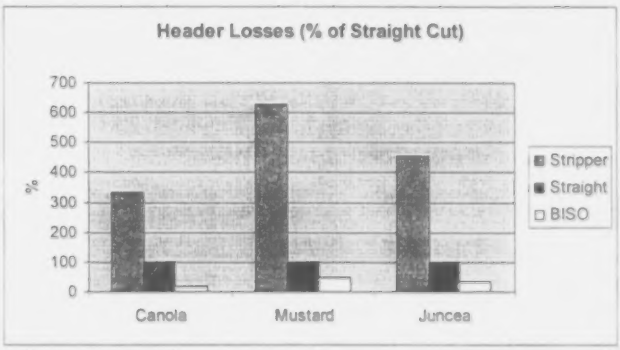
Stripper Type Header

- Greater travel speeds in most crops.
- Strips off pods leaving a good deal of stubble behind.
- Premiere header for cereals, flax, lentils and lodged crops.

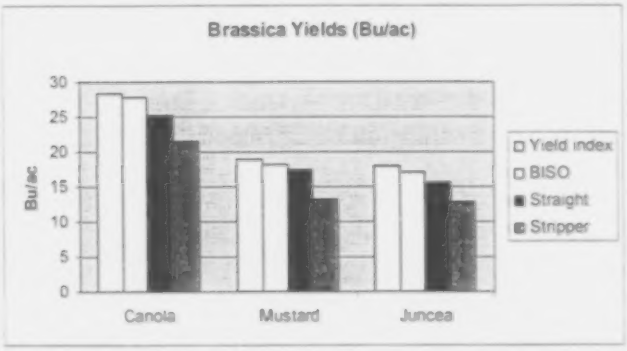


p1011771.mov

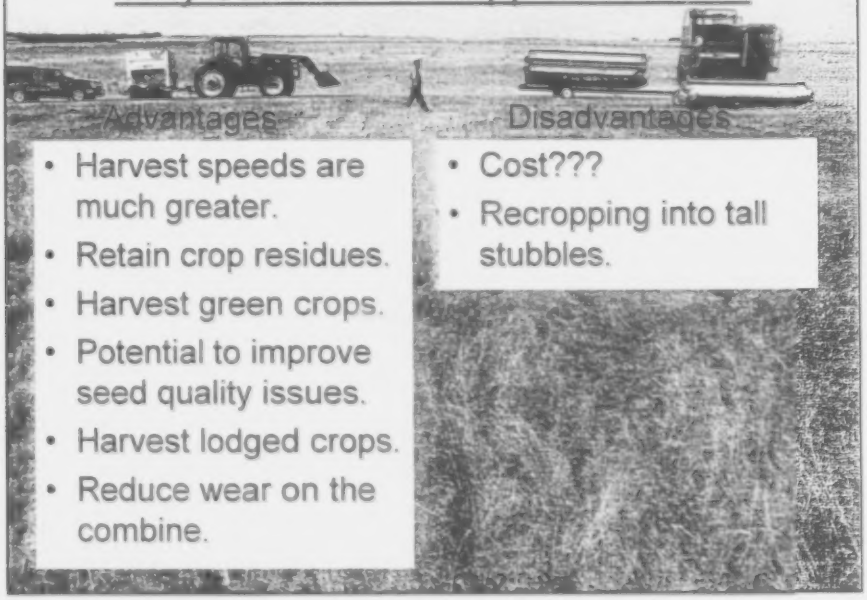
Header Losses



Resulting Yields



Why consider a Stripper Header?



Advantages

- Harvest speeds are much greater.
- Retain crop residues.
- Harvest green crops.
- Potential to improve seed quality issues.
- Harvest lodged crops.
- Reduce wear on the combine.

Disadvantages

- Cost???
- Recropping into tall stubbles.

Summary

- Stripper type headers have great potential in many crops (Cereals, pulses, flax, lodged crops)
- Excellent fit for biomass industries (biomass ethanol, fibre).
- Fast efficient harvest means better quality, as well as labour, fuel, and capitol savings.
- Retain stubbles over winter to reduce erosion and catch snow.
- *Do you need a big expensive, high capacity combine behind a stripper type header?*

Acknowledgement

Saskatchewan AgriARM

- Sask. Canola Development Commission.
- Sask. Pulse Growers.
- Mark Stumborg (AAFC).
- SAF, ADF
- Jay Dee Equipment
- BISO headers.
- Staff.

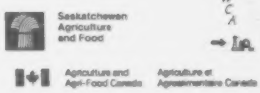


WCA

SPARC

SCDC Saskatchewan Canola Development Commission

Whole Crop Utilization Workshop





Canada

Role of Equipment

- High Cost
  - Farming investment = gross revenue
  - Major cost of plant
- Key to getting the job done
  - Everything hasn't been invented
  - We don't know everything
- Machinery R & D is not sexy
  - R & D is expensive and risky
  - Manufacturers aren't good inventors
  - Afterwards it looks simple

What is wrong with present equipment?

- Focused on Wrong Target

Farmer Focus

- Raise Food & Feed Efficiently
  - grow high quality (varieties)
  - maximize production (fertilizer, pesticides, technique)
  - continuous crop (manage residue)
  - select machines (maximum productivity, minimum labor)

RESULTS

BINGO!

- High productivity per person
- High quality over high yield
- Premium product competing with low price one
- Cost to produce greater than revenue

Machinery Focus

- Respond to Customer Demand

  - Bigger – cover more ground
  - Faster – more capacity
  - More comfort – longer hours
  - Deal with residue

RESULTS

BINGO!

- Bigger, faster, more comfortable
- Better residue management
- More costly
- Cost effective not cost efficient

COST EFFECTIVE

- Better than next alternative
- Relies on "economy of scale" (works until profit = 0)

COST EFFICIENT

- Less investment
- Higher productivity
- Higher quality products
- Less maintenance
- Less depreciation
- Less fuel (unit of harvest)

What If Focus Was?

- Produce Products for Profit?

Results

- More Valuable Crops
  - Different (industrial use)
  - Higher yield/utilization
  - Targeted qualities
- Contracted Price
- Better Profit Margin
- Cost Efficient Equipment

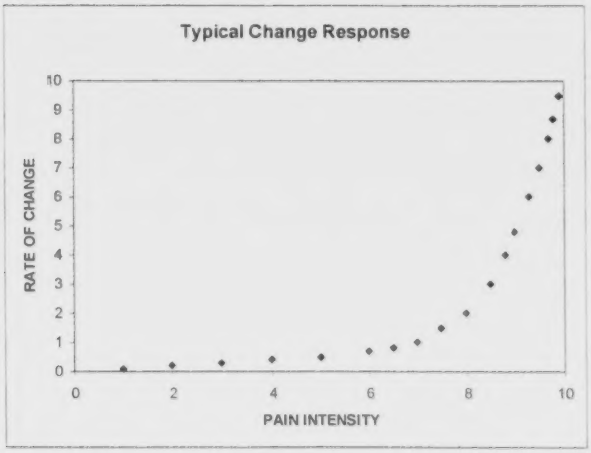
What if Manufacturer's Focus Was ...

- Cost Efficient Equipment?

Results

- Bigger, Faster, Less Labor
- Less Cost Per Unit of Harvest
  - Lower initial cost
  - Less fuel/unit
  - Less maintenance
  - Less depreciation
- Quality Product

How Fast Will Things Change?



Crops

Slow - if

- price (profitable)
- Subsidy on production
- No alternatives
- No demand
- No Industrial Use
- No R & D

Fast - if

- price (profitable)
- Subsidy on production
- Alternatives available
- Demand Strong
- Industrial Use
- R & D Support

Equipment

Slow - if

- Not profitable
- Low Demand
- R & D Required

Fast - if

- Affordable
- Profitable
- High Demand
- Adaptable (existing technology)

Up Side

- Prairie Farmer Inventive
- Prairies have Manufacturing Capabilities
- We have R & D Capabilities
- Promising Technology
  - Stripper Header
    - Available
    - Adaptable to current harvesters
    - Higher Harvest Rates
    - More Quality Options
    - Efficiency Opportunities

Requirements

- Field Studies (Modern Combine)
  - Performance
  - Economics
  - Quality
- Develop Option (Specialized)
- Companion Systems

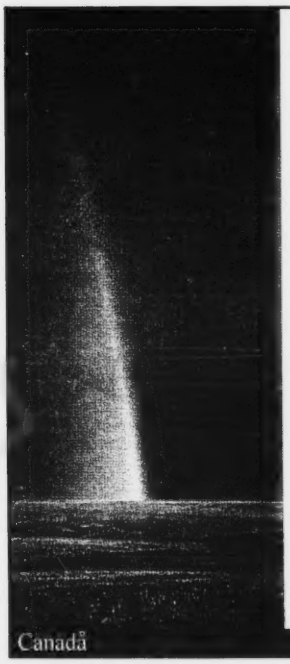
Opportunities

- Cost Efficient Equipment (Present Crops)
- Better Utilization of Whole Crop
- Local Industry Development
- More Effective Processing
- Build on Natural Advantages

APPENDIX V

Appendix V

2007 Harvest System Workshop Presentation



Harvest Workshop Progress Report

By: Mark Stumborg, P.Eng.
Agriculture and Agri-Food Canada
Swift Current, Saskatchewan

Agenda

1. Review field evaluation progress of alternative harvest systems based on the Shelbourne stripper header.
2. Review current straw evaluation activities comparing straw harvested from different systems.
3. Identify & prioritize opportunities for field and demonstration scale plot research for the 2007 crop year.
4. Identify & prioritize opportunities for laboratory and pilot scale quality evaluation research for the 2007 – 2008 fiscal year.
5. Formalize partnerships and potential funding contributions to realize significant progress against the identified opportunities and priorities.

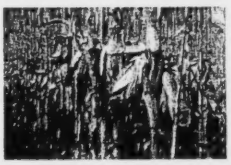
US Biomass Targets

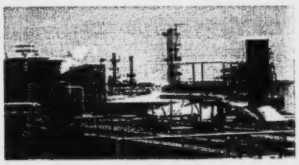
	2010	2020	2030
BioPower Biomass share of electricity & heat demand in utilities & industry.	4% (3.3 quads)	5% (4.0 quads)	5% (5.0 quads)
BioFuels Biomass share of demand for transportation fuels.	4% (1.3 quads)	10% (4.0 quads)	20% (9.5 quads)
BioProducts Share of target chemicals that are biobased.	12%	18%	25%

1 Billion Tons

Vision for Bioenergy and Biobased Products in the United States, October 2002

The Opportunity: An Integrated Industry





Biomass Feedstocks

Trees
Grasses
Agricultural Crops
Agricultural Residues
Animal Wastes
Municipal Solid Waste

Bioconversion Biorefining

Enzymatic Fermentation
Gas/liquid Fermentation
Acid Hydrolysis/Fermentation
Gasification
Combustion
Co-firing

USES

Fuels:
Ethanol
Renewable Diesel

Electricity

Heat

Chemicals
Plastics
Solvents
Pharmaceuticals
Chemical Intermediates
Phenolics
Adhesives
Furfural
Fatty acids
Acetic Acid
Carbon black
Paints
Dyes, Pigments, and Ink
Detergents

Food and Feed

Goals

1. Determine the amount of crop residues available from conventional harvest systems currently employed.
2. Develop improved harvest systems that reduce biomass losses, improve or preserve biomass quality, and reduce the cost of the biomass collected;
3. Evaluate the energy potential of residues by conversion to ethanol, gasification to heat, power and chemicals, and pyrolysis for the production of bio-oils for energy and chemicals;
4. Evaluate the potential for novel harvest systems to improve the quality and quantity of residues collected, especially flax, as a bioproducts feedstock for natural fibre products;
5. Provide detailed quantity, quality, energy, and carbon/nitrogen cycle data to the Cross-Cutting thread activity proposed to model and analyze the biomass system from soil to grave.

Crops, Partners, and Locations

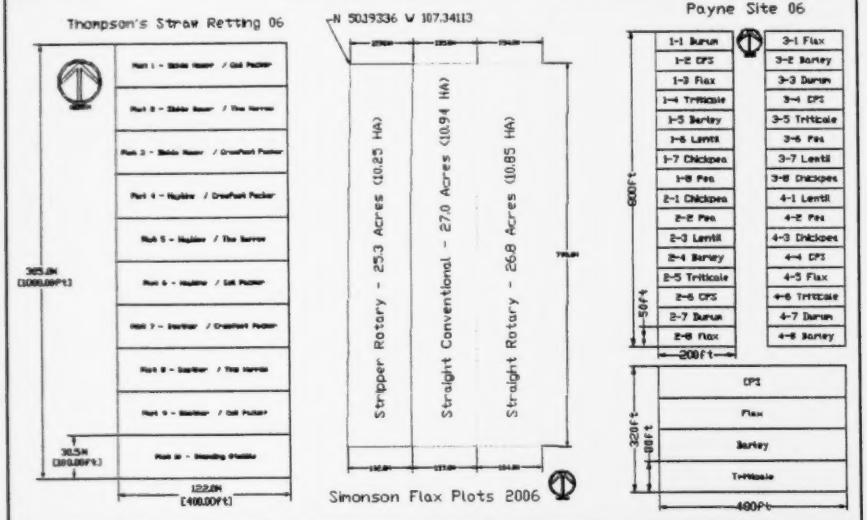
1. Swift Current
   - Wheatland Conservation
2. Canora
   - East Central Research Foundation

1. CPS Wheat
2. Durum*
3. Flax
4. Barley
5. Triticale
6. Oats**
7. Lentils
8. Peas
9. Chickpeas*

* Planted at Swift Current only.

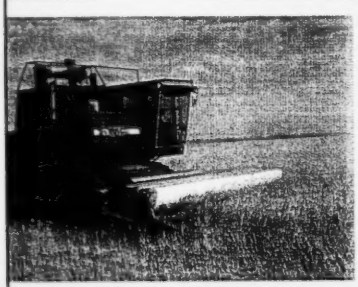
** Planted at Canora only.

Plot Activity

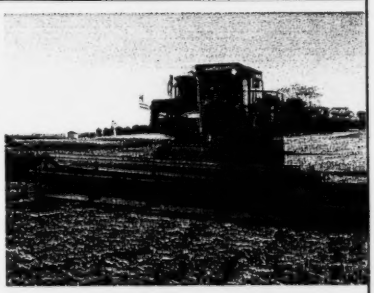


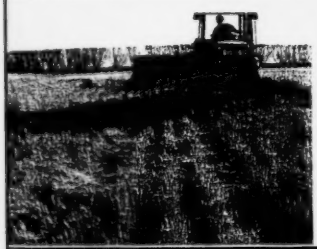
Canada Harvest Workshop March 14th, 2007

Equipment: Based on Massey 550



Harvest





Baling

Binding

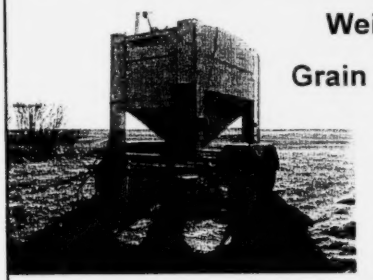


Canada Harvest Workshop March 14th, 2007

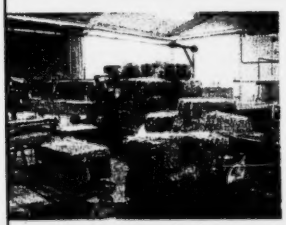
Weighing Equipment

Weigh Wagons

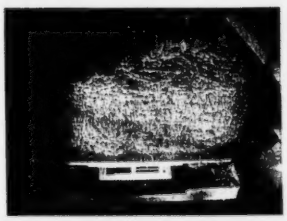
Grain **Chaff**



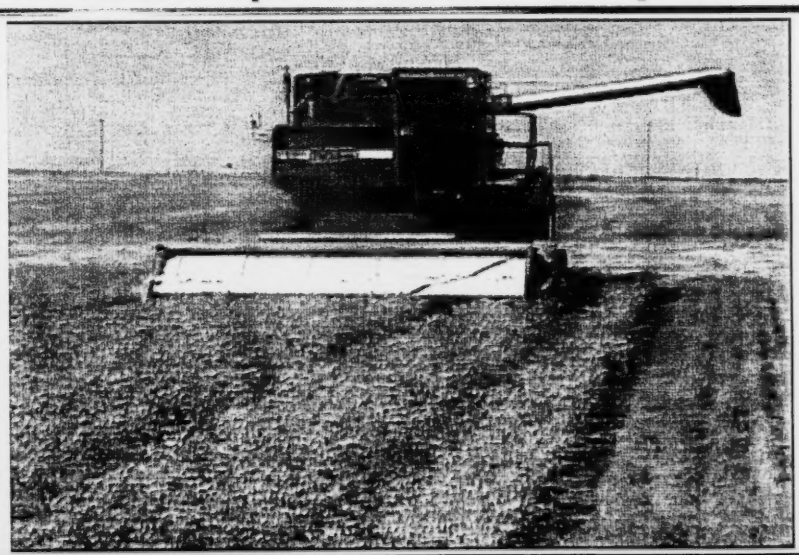




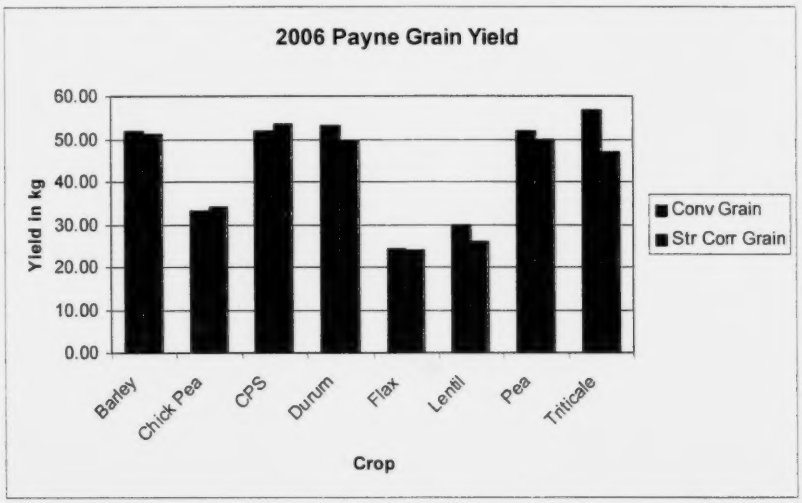
Platform Scale



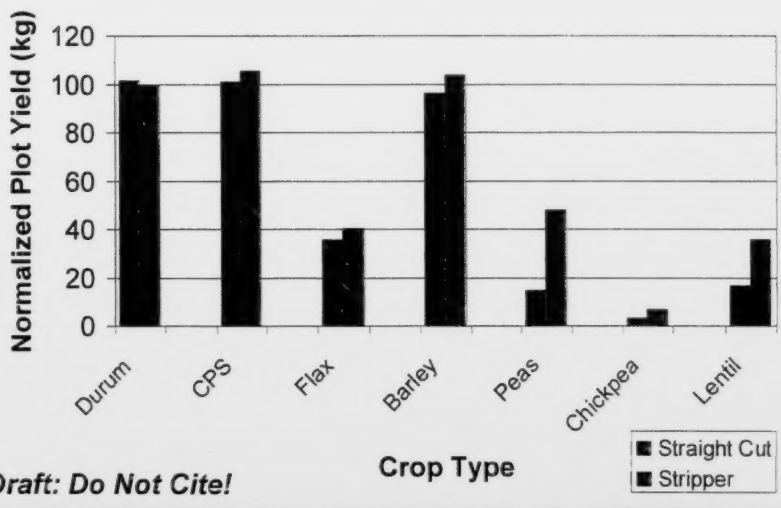
Header Operation in Chickpeas



SC 2006 Small Plot Grain Yields

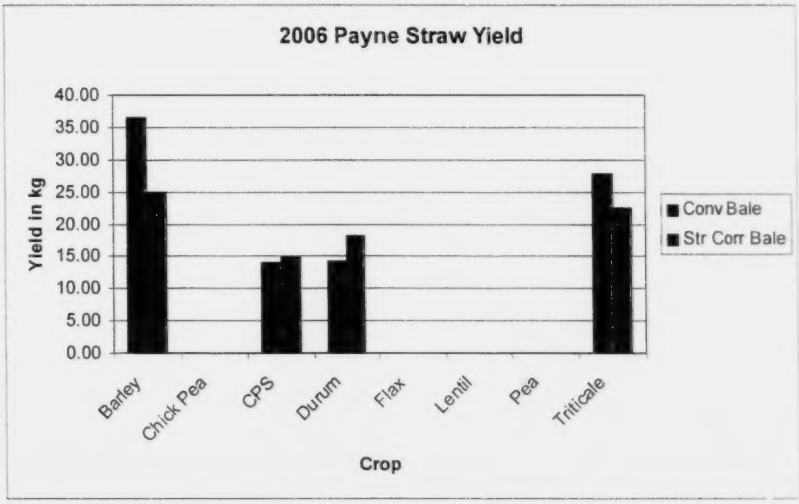


Small Plot Grain Yields (2005)

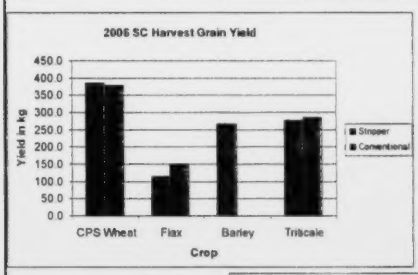


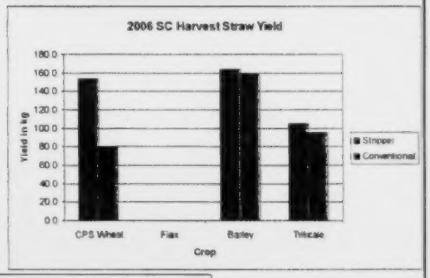
Draft: Do Not Cite!

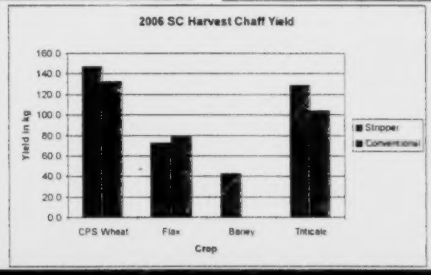
SC 2006 Small Plot Straw Yields



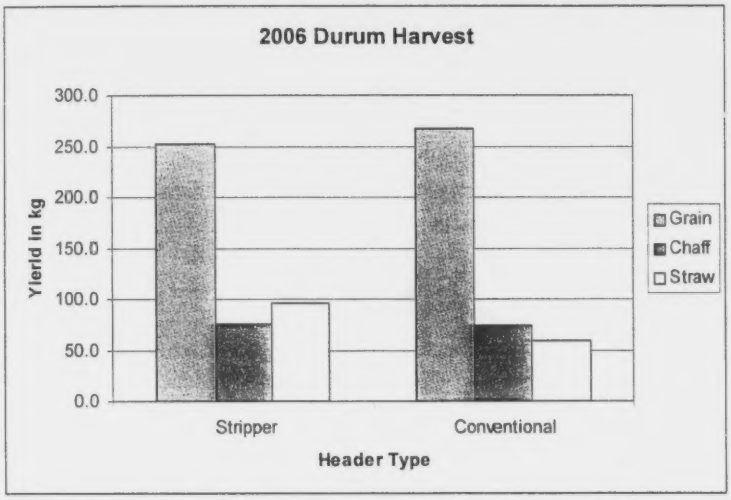
SC Biomass Plots







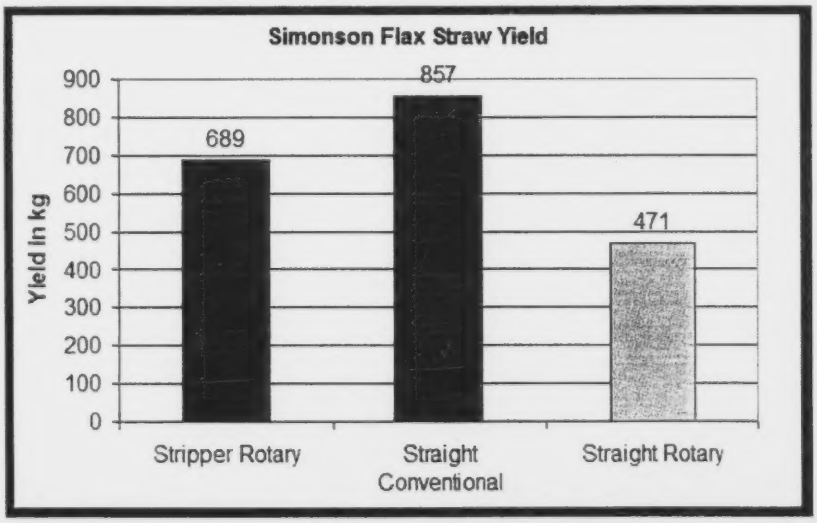
SC "Extra" Durum Plots



Canada

Harvest Workshop March 14th, 2007

2006 Simonson Straw Yields



Canada

Harvest Workshop March 14th, 2007

Successful Fibre Production..

1. Proper choice of variety.
2. Agronomics.
3. Harvest methodology.
4. Retting treatments.
5. Collection system.
6. Luck.

Beneficial Management Practices

B. Irvine, J. McConnell, A. Ulrich, G. Lafond, B. May, G. Hultgreen

1. Seeding rate at least double that for oilseed production
2. Uniform seeding depth
3. Narrow rows not necessary
4. Cultivar has a major impact
5. Cultivar does not interact with seeding system.

Fibre Yield from Simonson's

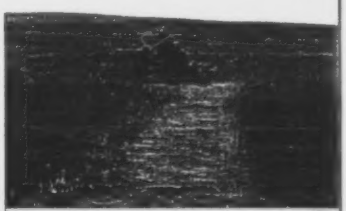
	Straw Yield kg acre^{-1}	Cellulose Content %	Cellulose Yield kg acre^{-1}	Cellulose % Case IH
Massey + Straight	418	55.9	81.3	114.0
Massey + Shelbourne	496	58.8	80.1	112.3
Case IH + Straight	412	55.4	71.3	100.0

Flax Retting for Fibre Improvement

Biolin Research, Simonson Farms & Thompson Farms

- Fibre for composites, textiles, pulp & other material uses.
- Harvest impact on fibre quality.

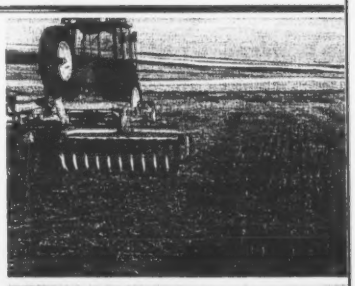
Cutting Treatments





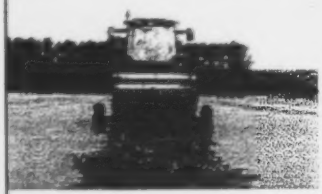


Packing Treatments

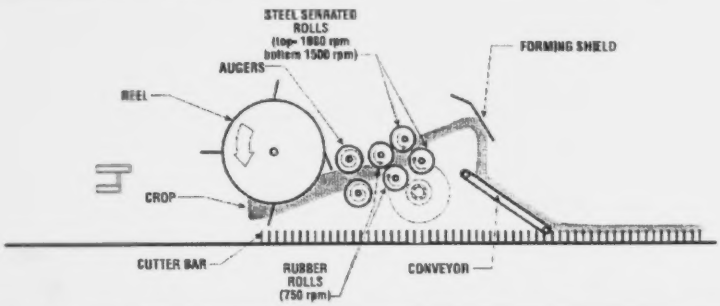





Possible Equipment Concepts

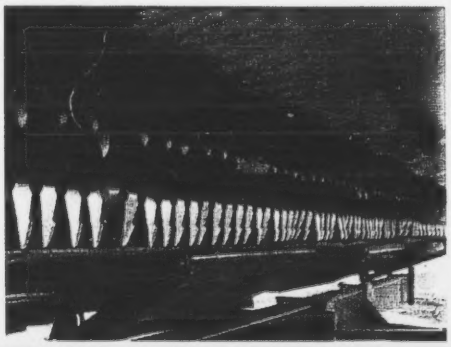


1. In-Field Retting Acceleration
   - Macerator
   - Conditioner
2. In-Field Partial Decortication



Stripper Header Issues

1. Rock Damage
   - Header height adjustment on hilly terrain.
   - Possible solution may be sonar height control and/or gauge wheels.



Stripper Header Issues

2. Bull Nose Adjustment:
   - Difficult to adjust according to variable crop height or condition.
   - Excessive interference causes increased straw breakage & material loss.





Stripper Header Issues

3. Timing of Flax Harvest:
   - Flax seed was harvested dry at Swift Current on August 14, 2006 using SaskFlax Shelbourne header.
   - Green straw increased energy requirement for header.
   - Extra time may be available for retting.
   - Straw is at Schweitzer for processing.



General Combine / Stripper Operation

1. Rotor Speed:
   - Generally @ high end of recommended
2. Sieve Setting:
   - Generally tighter than conventional setting
3. Fan Setting:
   - Lower or substantially lower than conventional
4. Cylinder Speed:
   - Lower or substantially lower for pulses and barley
5. Concave Setting:
   - Closer for cereals, wider for pulses than normal
6. Forward Speed:
   - Higher than conventional, but limited by traction drive and operator comfort
7. Fuel Economy:
   - No difference for "green" flax at Simonson's

Changes to Plot Activity

1. Longer Plots (400' not 200').
2. Larger biomass plots to allow for improved combine setting.
3. Swathing immediately after stripping operation is complete.
4. Quality analysis on the pulse crops and barley.

Additions to Large Scale

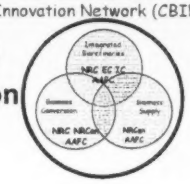
1. Dates of harvest versus retting
2. Retting improvement through mechanical action
3. Fibre evaluation
4. Locations
5. Amounts
6. Cooperators

Partnerships

Crop Fibres Canada



The Canadian Biomass Innovation Network (CBIN)



Wheatland Conservation

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ARC-CARC

Schweitzer-Mauduit



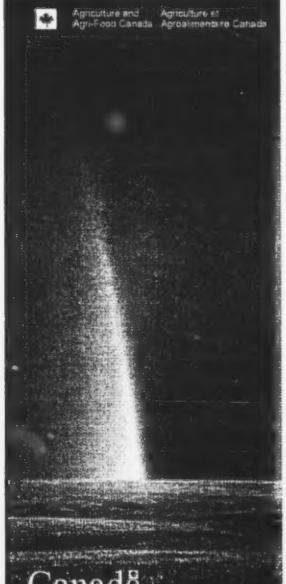
SaskFlax

COMPOSITES innovation CENTRE

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Harvest Workshop March 14th, 2007

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada



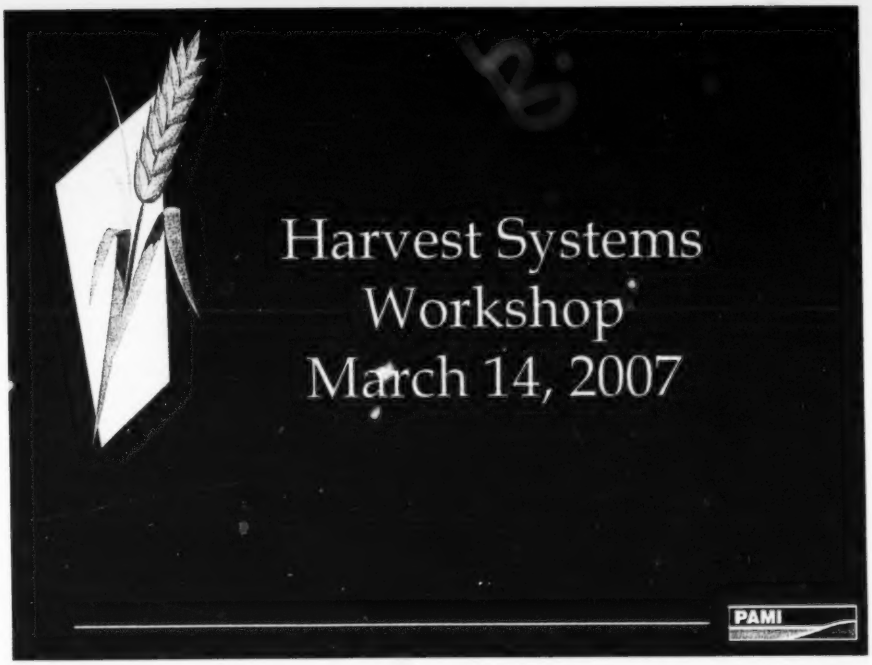
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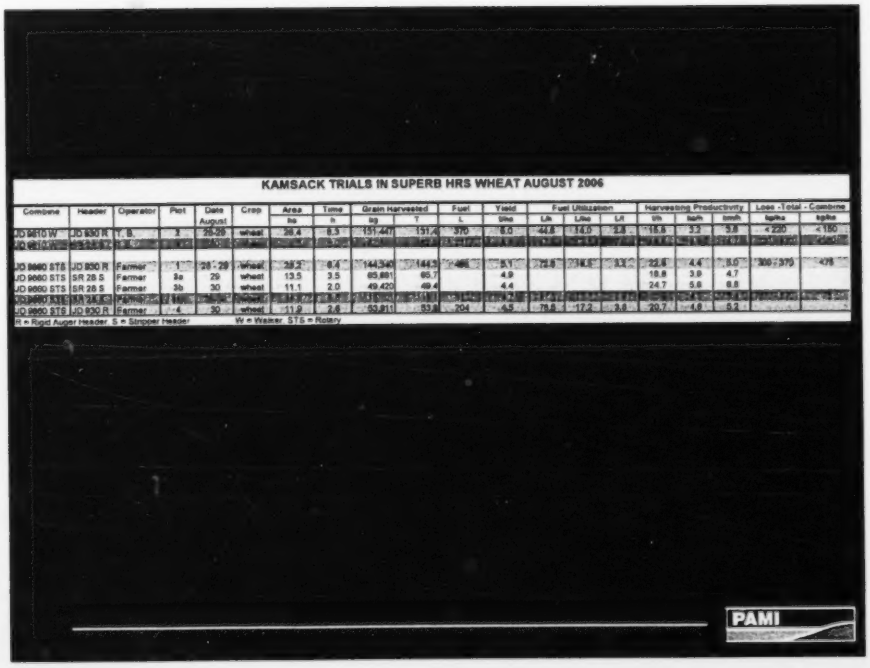
Questions ?

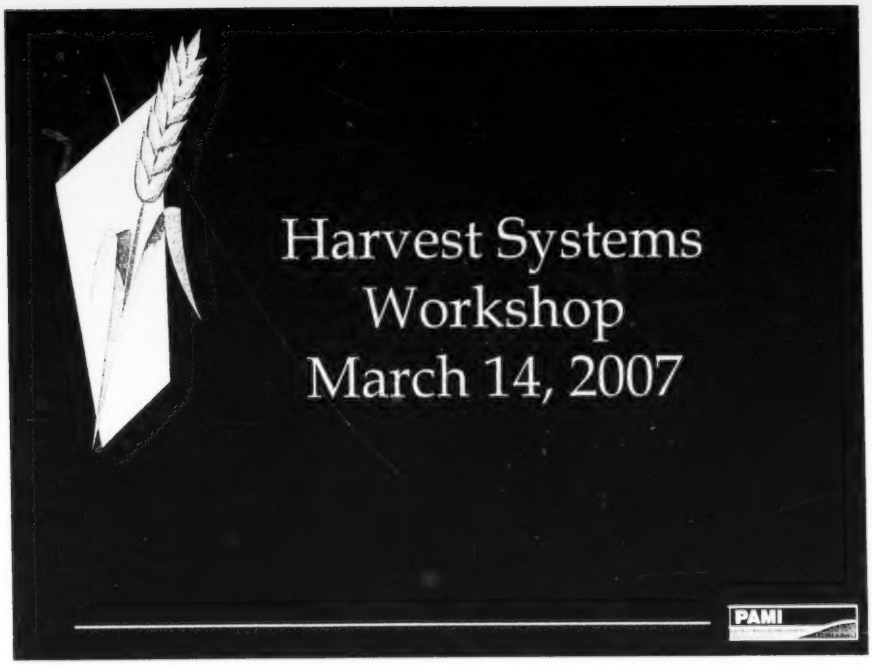
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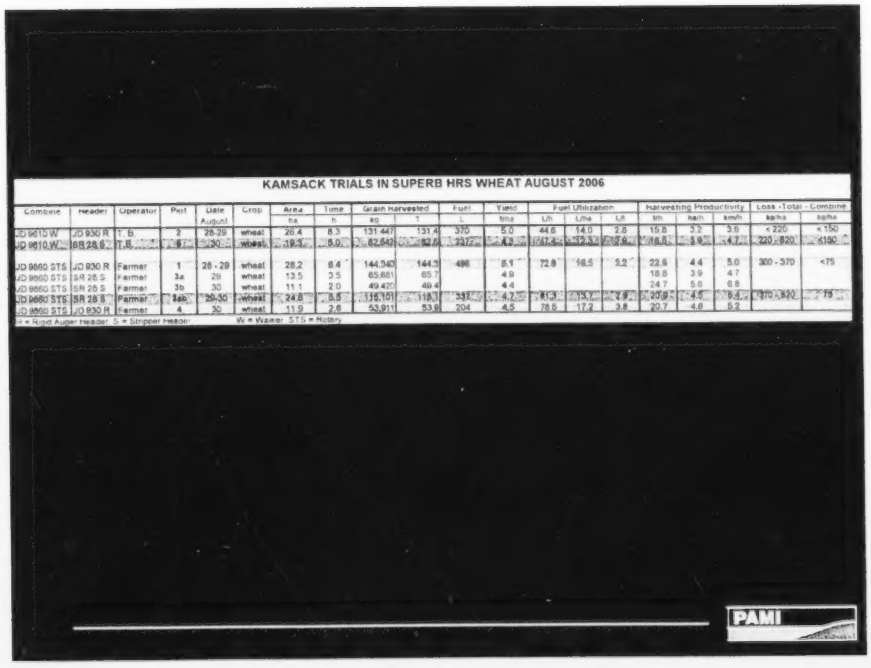
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Harvest Workshop March 14th, 2007


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KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006
Combine
Header
Operator
Plot
Date August
Crop
Area
Time
Grain Harvested
Fuel
Yield
Fuel Utilization
Harvesting Productivity
Loss - Total - Combine
ha
h
kg
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l/t
t/h
ha/h
t/h
kg/ha
kg/ha
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151.4
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JD 9660 STS
JD 930 R
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144.3
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234.5
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R = Rigid Auger Header S = Stripper Header
W = Waaker STS = Rotary
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KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006
Combine
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Date
August
Crop
Area
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Time
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Grain Harvested
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Harvesting Productivity
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Loss - Total - Combine
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2.8
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< 150
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SR 28.8
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R = Rigid Auger Header S = Stripper Header
W = Waiter STS = Rotary
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KAMSACK TRIALS in SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Total - Combine Loss	
						acres	h	pounds	bushels	Litres	bu/ac	L/h	L/ac	bu/L	bu/h	ac/h	mph	bu/ac	bu/ac
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	65.3	8.3	289787	4835	370	69	44.6	5.7	12.26	546	7.9	2.2	< 1.5	< 1.0
JD 9610W	SR 26 S	T. B.	3	30-31	wheat	27.7	3.5	118170	1937	160	70	45.7	5.8	12.12	549	7.8	2.2	< 1.5	< 1.0
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	69.8	8.4	318210	4980	486	71	72.8	8.7	10.69	776	10.9	3.1	2-2.5	<0.5
JD 9860 STS	SR 26 S	Farmer	3a	29	wheat	33.3	3.5	144800	2266		68				647	9.5	2.9		
JD 9860 STS	SR 26 S	Farmer	3b	30	wheat	27.5	2	108950	1705		62				853	13.8	4.2		
JD 9860 STS	SR 26 S	Farmer	3	29-30	wheat	60.8	5.5	253760	3974	345	65	63.0	8.6	11.51	722	11.5	3.7	2.5 - 3.5	< 0.5
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	29.3	2.6	118862	1860	204	63	78.5	7.0	9.11	715	11.3	3.2		

R = Rigid Auger Header S = Stripper Header W = Walker STS = Rotary

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REDVERS TRIALS IN FLAX AUGUST - SEPTEMBER 2006 - Metric

Combine	Header	Operator	Plot	Date Aug-Sept	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss - Total - Combine	
						ac	h	kg	T	L	t/ha	L/h	L/ha	L/t	t/h	ha/h	km/h	kg/ha	kg/ha
JD 9600 W	JD 930 R	Farmer	8B	31-1	Flax	15.7	3.6	20,830	20.8	XX	1.3	XX	XX	XX	5.7	4.3	7.0	XX	XX
JD 9610 W	SR 26 S	Farmer	8A	31-1	Flax	9.7	2.3	13,900	13.7	XX	1.4	XX	XX	XX	5.9	4.2	6.9	XX	XX
JD 9860 STS	Honeybee	PAMI	5S	30-1	Flax	4.5	0.8	3,945	3.9	XX	0.9	XX	XX	XX	4.8	5.5	8.9	XX	XX
JD 9860 STS	Honeybee	PAMI	5A	30-31	Flax	9.5	1.9	8,315	8.3	XX	0.9	XX	XX	XX	4.4	5.0	8.1	XX	XX
JD 9860 STS	Honeybee	PAMI	5S	30-31	Flax	1.6	0.3	1,656	1.7	XX	1.0	XX	XX	XX	5.7	5.5	8.9	XX	XX

R = Rigid Auger Header S = Stripper Header W = Walker STS = Rotary

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REDVERS TRIALS IN FLAX AUGUST - SEPTEMBER 2006 - Imperial

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss - Total - Combine	
				Aug-Sep		ac	h	lb	bu	gal	bu/ac	gal/h	gal/ac	bu/gal	bu/h	ac/h	km/h	bu/ac	bu/ac
JD 9600 W	JD 930 R	Farmer	6B	31-1	Flax	36.8	3.8	45,828	816.3	XX	21.1	XX	XX	XX	227.3	10.8	7.0	XX	XX
JD 9610 W	SR 28 S	Farmer	1 B	29-30	Flax	27.6	3.0	34,416	613.1	XX	22.2	XX	XX	XX	204.4	9.2	6.8	XX	XX
JD 9860 STS	Honeydiee	PAMI	5S	30-1	Flax	11.1	0.8	8,679	155.0	XX	13.9	XX	XX	XX	193.7	13.9	8.9	XX	XX
JD 9610 W	SR 28 S	PAMI	2 B	30-31	Flax	27.6	2.7	34,416	613.1	XX	22.2	XX	XX	XX	227.5	10.2	7.0	XX	XX
JD 9860 STS	Honeydiee	PAMI	5S	30-31	Flax	3.9	0.3	3,641	65.0	XX	16.5	XX	XX	XX	218.7	13.1	8.9	XX	XX

R = Rigid Auger Header SR = Stripper Header SS = Single Seeded DS = Double Seeded W = Walker STS = Rotary

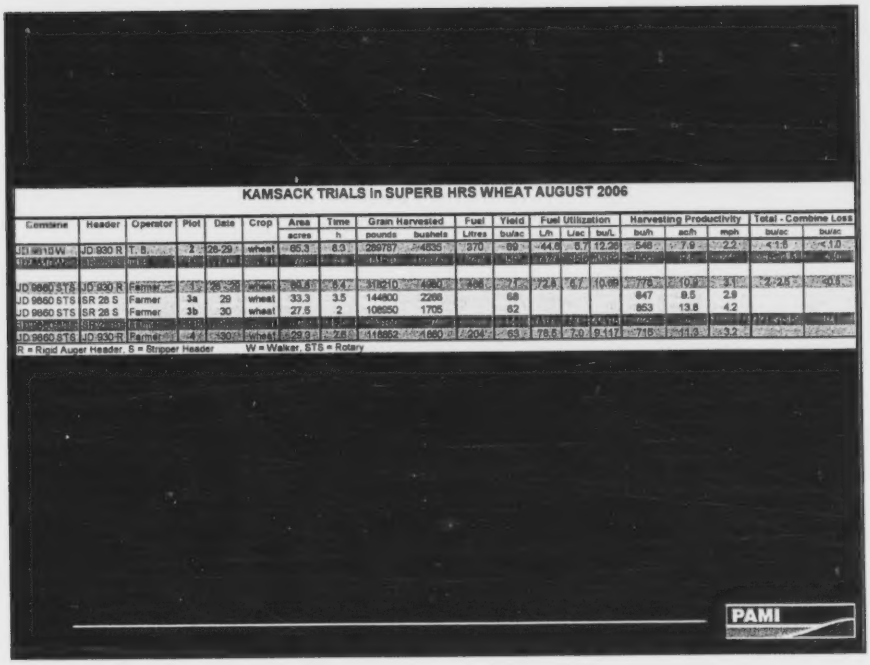
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KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot #	Date August	Crop	Area	Time	Fuel	Grain Harvested		MOG Baled		GrainYield	MOG Yield	MOG/G
						ha	h	L	kg	t	kg	t	t/ha	t/ha	Ratio
JD 9610 W	JD 930 R	T. B.	2	28-29	wheat	26.4	8.3	370	131,447	131.4	78586	78.6	5.0	3.0	0.605
JD 9610 W	SR 28 S	T. B.	4	30	wheat	26.4	6.4	297	127,642	127.6	40102	40.0	4.8	1.5	0.315
JD 9860 STS	JD 930 R	Farmer	1	28 - 29	wheat	28.2	6.4	466	144,340	144.3	42838	42.8	5.1	1.5	0.295
JD 9860 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5		65,681	65.7			4.9		
JD 9860 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0		49,420	49.4			4.4		
JD 9860 STS	SR 28 S	Farmer	3ab	29-30	wheat	24.6	5.6		115,101	115.1	58672	58.7	4.7	2.4	0.510
JD 9860 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.6	204	53,911	53.9	34110	34.1	4.5	2.9	0.633

R = Rigid Auger Header S = Stripper Header W = Walker STS = Rotary

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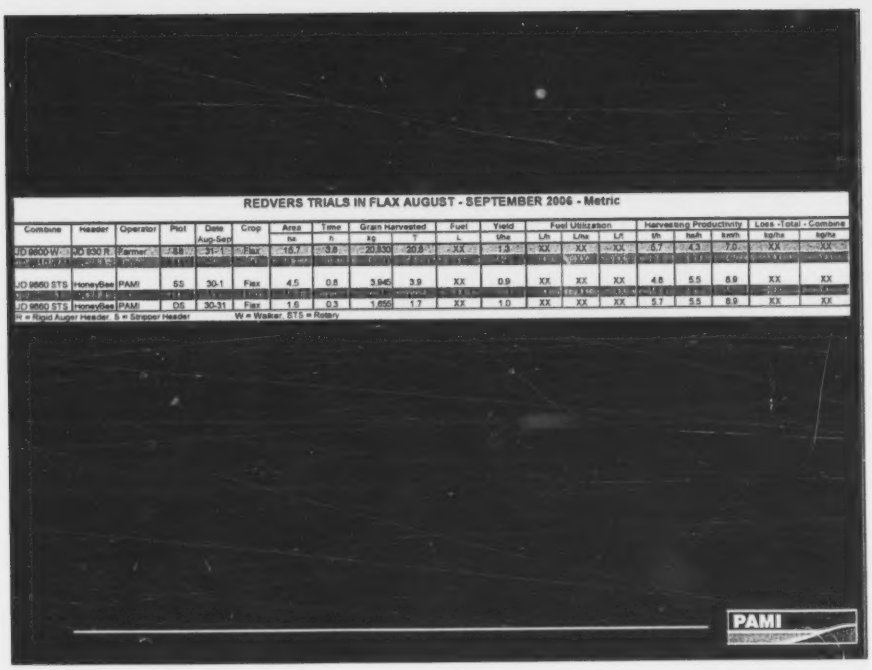


KAMSACK TRIALS in SUPERB HRS WHEAT AUGUST 2006

Combine	Header	Operator	Plot	Date	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Total - Combine Loss	
						acres	h	pounds	bushels	Litres	bu/ac	L/h	L/ac	bu/L	bu/h	ac/h	mph	bu/ac	bu/ac
JD 9600 W	JD 930 R	T. B.	2	28-29	wheat	66.3	8.9	289787	4833	870	69	44.6	6.7	12.26	546	7.9	2.2	1.6	1.0
JD 9660 STS	JD 930 R	Farmer	3	28-29	wheat	84.6	8.4	318210	4980	1208	71	72.8	6.7	10.69	778	10.9	3.1	2.25	0.8
JD 9660 STS	SR 28 S	Farmer	3a	29	wheat	33.3	3.5	144800	2268		68				847	9.5	2.9		
JD 9660 STS	SR 28 S	Farmer	3b	30	wheat	27.5	2	108950	1705		62				853	13.8	4.2		
JD 9660 STS	JD 930 R	Farmer	4	30	wheat	29.3	2.8	118862	1860	204	63.2	76.5	7.0	9.147	716	11.3	3.2		

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

PAMI

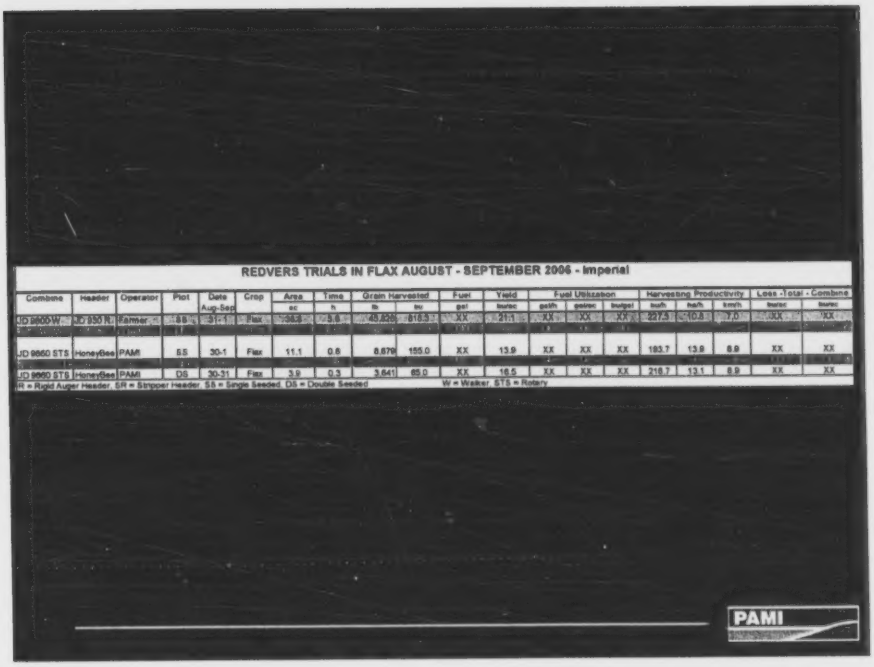


REDVERS TRIALS IN FLAX AUGUST - SEPTEMBER 2006 - Metric

Combine	Header	Operator	Plot	Date Aug-Sept	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss -Total - Combine	
						ha	h	kg	T	L	t/ha	L/h	L/ha	L/t	t/h	ha/h	km/h	kg/ha	kg/ha
JD 9600 W	JD 930 R	Farmer	4B	31-1	Flax	16.7	3.9	20,830	20.8	XX	1.3	XX	XX	XX	5.7	4.3	7.0	XX	XX
JD 9660 STS	HoneyBee	PAMI	5S	30-1	Flax	4.5	0.8	3,945	3.9	XX	0.9	XX	XX	XX	4.8	5.5	8.9	XX	XX
JD 9660 STS	HoneyBee	PAMI	5S	30-31	Flax	1.6	0.3	1,655	1.7	XX	1.0	XX	XX	XX	5.7	5.5	8.9	XX	XX

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary

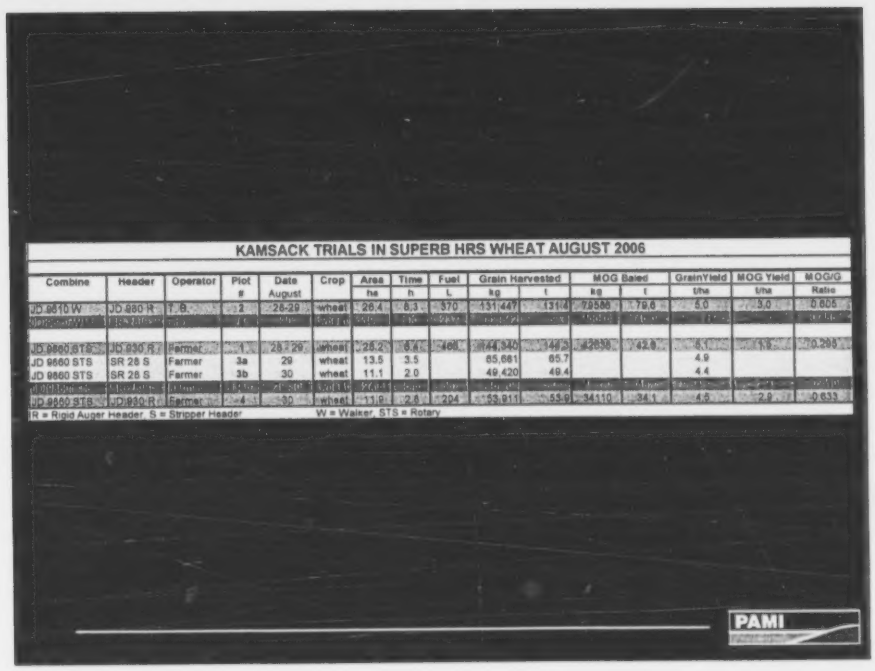
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REDVERS TRIALS IN FLAX AUGUST - SEPTEMBER 2006 - Imperial

Combine	Header	Operator	Plot	Date Aug-Sep	Crop	Area	Time	Grain Harvested		Fuel	Yield	Fuel Utilization			Harvesting Productivity			Loss - Total - Combine	
						ac	h	lb	bu	gal	bu/ac	gal/h	gal/ac	bu/gal	bu/h	ac/h	km/h	bu/ac	bu/ac
JD 9650 W	JD 930 R	Farmer	6B	31-1	Flax	13.8	5.6	48,226	816.5	XX	21.1	XX	XX	XX	227.5	10.0	7.0	XX	XX
JD 9660 STS	HoneyBee	PAMI	5S	30-1	Flax	11.1	0.8	8,679	155.0	XX	13.9	XX	XX	XX	193.7	13.8	8.9	XX	XX
JD 9660 STS	HoneyBee	PAMI	DS	30-31	Flax	3.9	0.3	3,641	65.0	XX	16.5	XX	XX	XX	218.7	13.1	8.9	XX	XX

R = Rigid Auger Header, SR = Stripper Header, SS = Single Seeded, DS = Double Seeded W = Walker, STS = Rotary

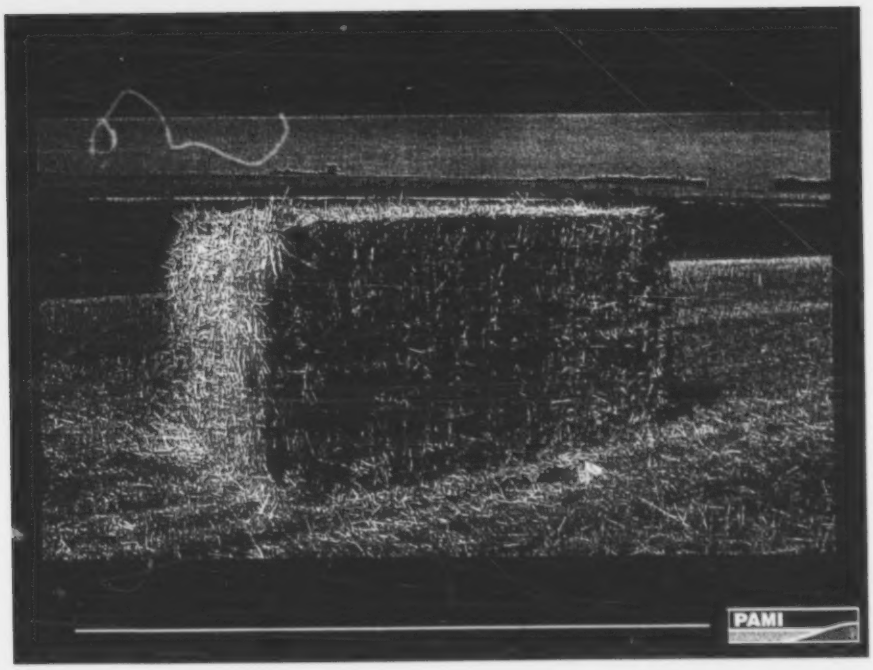


KAMSACK TRIALS IN SUPERB HRS WHEAT AUGUST 2006

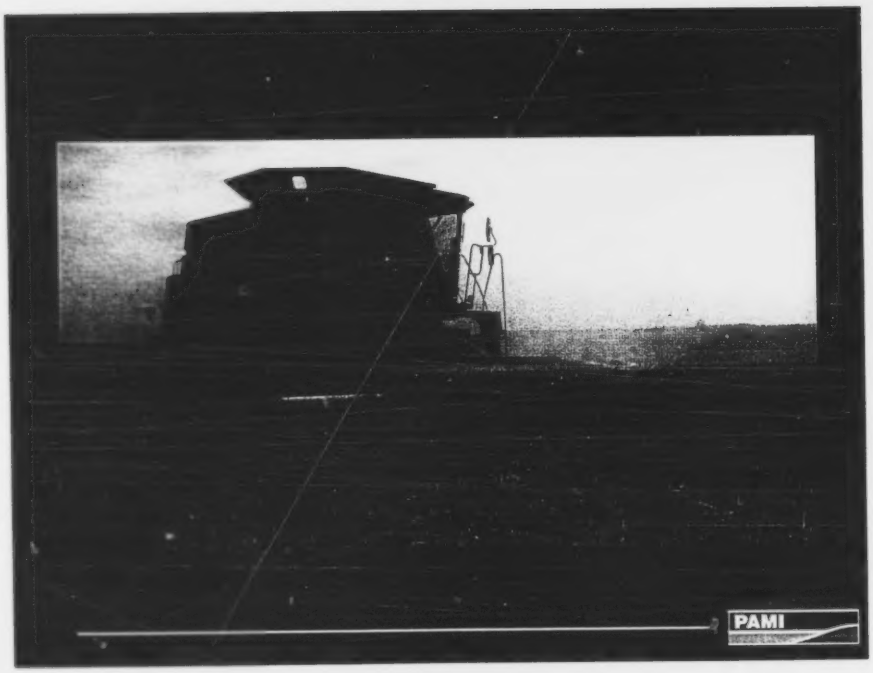
Combine	Header	Operator	Plot #	Date August	Crop	Area	Time	Fuel	Grain Harvested		MOG Baled		GrainYield	MOG Yield	MOG/G
						ha	h	L	kg	t	kg	t	t/ha	t/ha	Ratio
JD 9510 W	JD 930 R	T. B.	2	26-29	wheat	28.4	6.3	570	131,447	131.4	79586	79.6	5.0	3.0	0.605
JD 9660 STS	JD 930 R	Farmer	1A	28-29	wheat	26.2	5.4	468	144,940	144.9	42830	42.8	5.1	1.5	0.295
JD 9660 STS	SR 28 S	Farmer	3a	29	wheat	13.5	3.5		65,661	65.7			4.9		
JD 9660 STS	SR 28 S	Farmer	3b	30	wheat	11.1	2.0		49,420	49.4			4.4		
JD 9660 STS	JD 930 R	Farmer	4	30	wheat	11.9	2.8	294	53,911	53.9	34110	34.1	4.5	2.8	0.633

R = Rigid Auger Header, S = Stripper Header W = Walker, STS = Rotary


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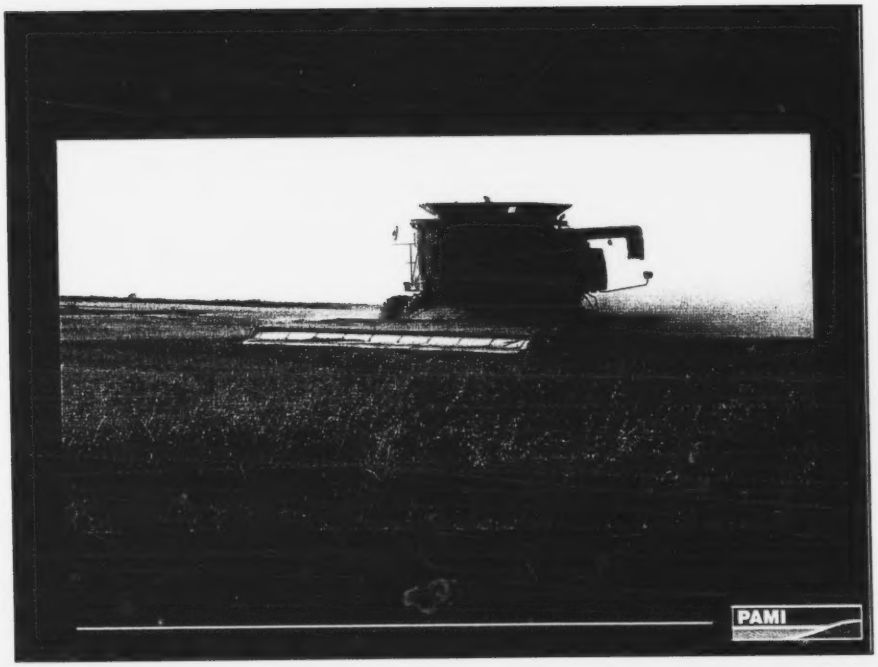

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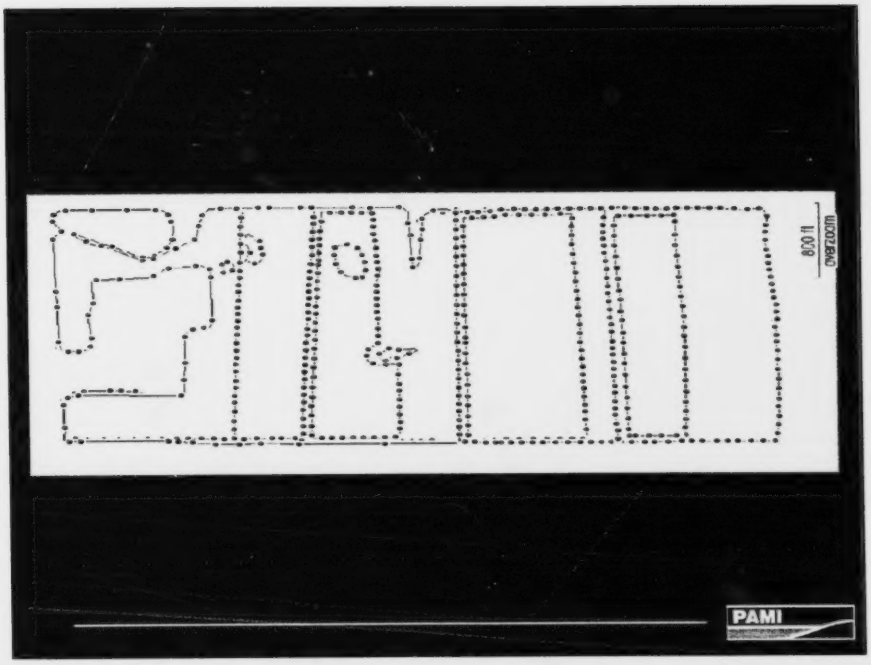

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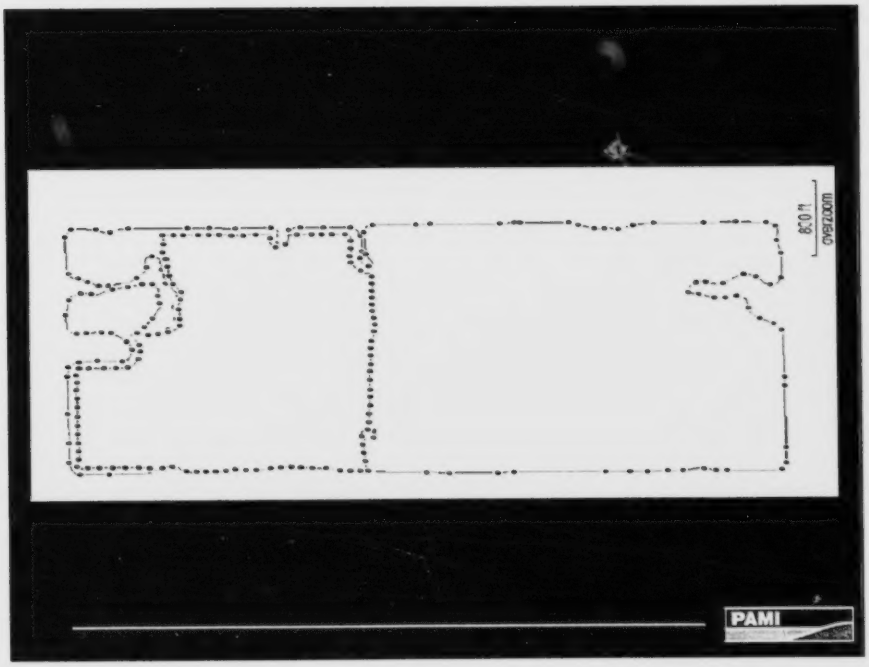

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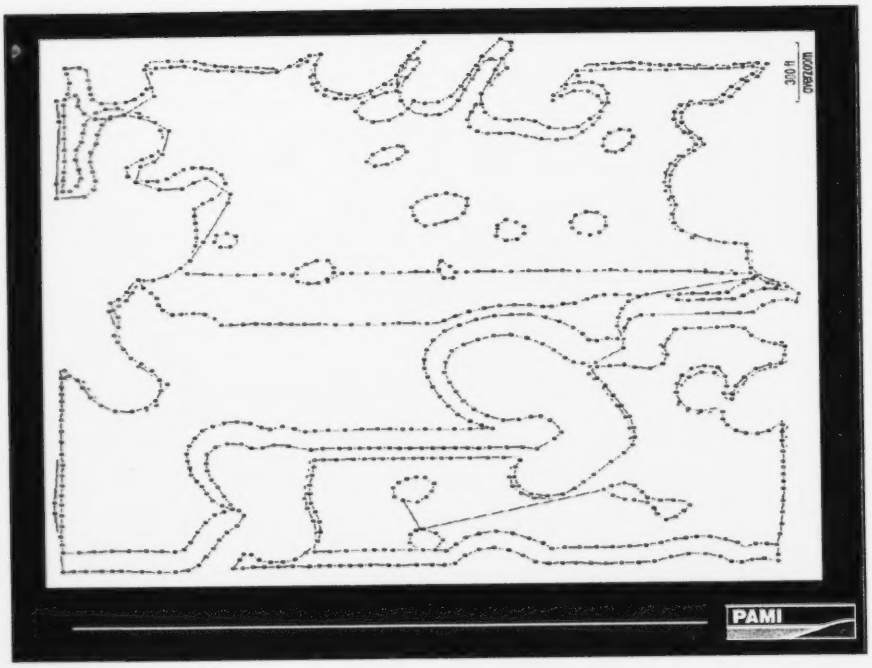

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overzoom
PAMI


overzoom
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Stripper Header Field Trials Discussion

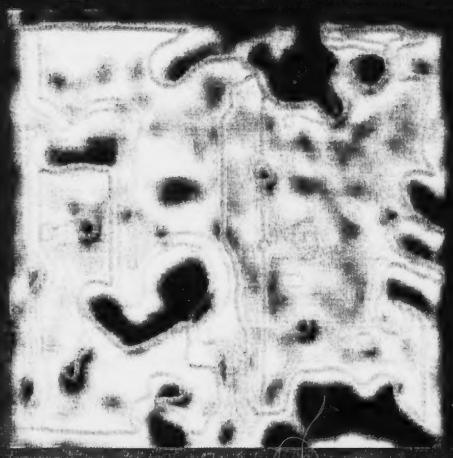


Applying Technology for Agriculture

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Field Trial Challenges

- Field / Crop Selection Variables
  - *Contour*
  - *Field Shape*
  - *Field Size*
  - *Crop Yield*
  - *Straw Yield*
  - *Crop Height*
  - *Straw Maturity*
  - *Grain Moisture*
  - *Ground Firmness*

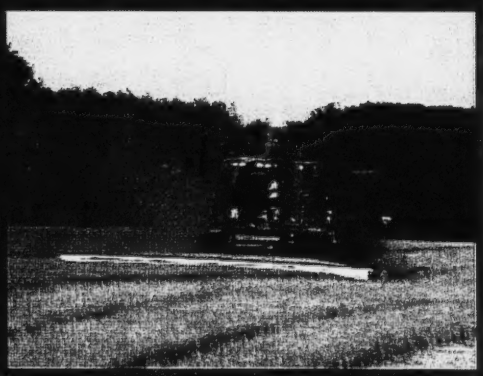


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Field Trial Challenges

- Harvester Variables
  - *Concave Clearance*
  - *Rotor / Cylinder Speed*
  - *Fan Speed*
  - *Front Beater Speed*
  - *Sieve Settings*
  - *Header Settings*
  - *Ground Speed*
  - *Cut Height*
  - *Cut Width*
  - *Chopper Speed*
  - *Stationary Knife Position*
  - *Grain Tank Size*
  - *Grain Tank Unload Rate*
  - *Wheel Footprint (Tramping)*



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Field Trial Challenges

- Weather Variables
  - *Temperature*
  - *Humidity*
  - *Sunny / Overcast*
  - *Wind Direction*
  - *Wind Speed*

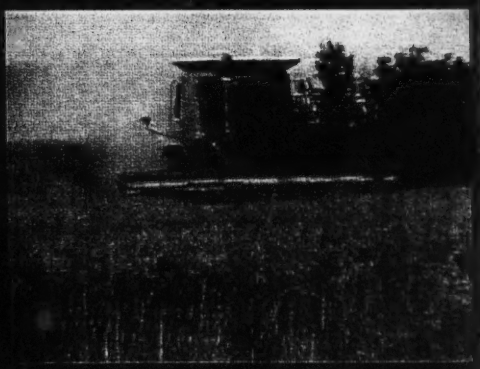


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Field Trial Challenges

- Data Collection Variables
  - *Harvester Ground Speed*
  - *Harvested Grain Weight*
  - *Harvester Grain Losses*
  - *Header Losses*
  - *Harvesting Time*
  - *Harvested Area*
  - *Harvester Cut Height*
  - *Harvester Cut Width*
  - *Harvester Fuel Usage*



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Field Trial Challenges

- Data Collection Variables
  - *Windrowing Time*
  - *Windrower Ground Speed*
  - *Time Between Harvest and Windrowing*
  - *Windrower Cut Height*
  - *Windrower Cut Width*
  - *Windrower Fuel Usage*

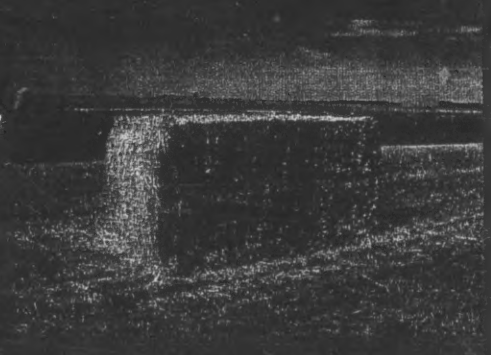


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Field Trial Challenges

- Data Collection Variables
  - *Baling Time*
  - *Baler Ground Speed*
  - *Time Between Windrowing and Baling*
  - *Bale Weights*
  - *Baling Losses*
  - *Straw Moisture*
  - *Straw Quality*
  - *Straw Length*
  - *Baler Fuel Usage*



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Suggested Test Method Improvements for 2007:

- Control of variables:
  - *Improve grain weight accuracy*
  - *Consistent cut height*
  - *No unloading on the go*
  - *Consistent Operators*
  - *Establish consistent ground speeds*
  - *Use fuel flow meters*
  - *Stricter fuel usage criteria*



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Suggested Test Method Improvements for 2007:

- Focus on collecting accurate data, not harvesting the field.
- Relieve pressure of grain transportation
  - ***Prefer a semi parked at the edge of the field***
- Section off plots
- Small versus large plot sizes?
  - ***Priority on accurate data.***
  - ***Many small plots versus few large plots?***



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Questions?



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